

SCIENCE

18 March 1960

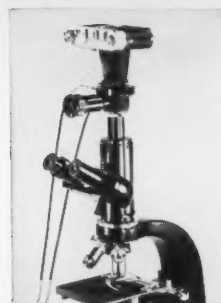
Vol. 131, No. 3403

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Gordon Research Conferences

*the
laboratory
microscope
which
fulfills
research
requirements*



For photomicrography and simultaneous observation, binocular photo tube "FS" is available

the new **LEITZ LABOLUX IIIa**

The Leitz Labolux IIIa is a new laboratory microscope with built-in illumination and the famous Labolux ball-bearing focusing control, which combines both coarse and fine focusing in a single knob. Available with a wide variety of accessories, the Labolux IIIa is recommended for all routine laboratory work and, in addition, can be equipped to fulfill the most exacting research.

A variety of interchangeable tubes is available: monocular, binocular or trinocular (binocular viewing plus photo tube for photomicrography). Tubes can be rotated 360° so that the Labolux IIIa may be faced away from the observer, for increased accessibility to all controls and to the object stage, and to make "conference-viewing" by two consultants more convenient.

Among the condensers available are the Abbe type, the Berek 2-diaphragm condenser, and condensers for phase contrast and dark field observations. The Labolux IIIa is readily adapted to fluorescence microscopy by addition of the Leitz fluorescence accessories. The large stand, in a new contemporary design, is constructed for a lifetime of use with fatigue-free operation and precision performance. All controls, including the knobs for the mechanical stage, are in a low convenient position. High-power objectives have spring-loaded mounts for prevention of damage to lenses and slides.

LABOLUX IIIa, Model S 25/95

- inclined binocular tube S with knurled knob to adjust for proper interpupillary distance • built-in mechanical stage #25 • two-lens condenser #95 • substage unit with rack and pinion focusing accepts sleeve-type condensers • quadruple nosepiece with achromats 3.5X, 10X, 45X and 100X oil immersion, the last two having spring-loaded mounts • paired 10X wide-field eyepieces • horizontal carrying case • 3-step transformer, 6 V, 2.5 Amp.

For literature and/or a personal demonstration in your laboratory, write Dept. SC-318



E. LEITZ, INC., 468 PARK AVENUE SOUTH, NEW YORK 16, N. Y.
Distributors of the world-famous products of
Ernst Leitz G. m. b. H., Wetzlar, Germany—Ernst Leitz Canada Ltd.
LEICA CAMERAS • LENSES • MICROSCOPES • BINOCULARS

32559

Biochemicals under
the microscope are
S.O.P.* at NBCo.
We are constantly
striving to explore
today's unknowns to
aid thousands of
investigative and
research chemists all
over the world in
their search for
healthier living for
all mankind.

An inside look at Biochemicals . . .

We offer more than
2,600 Biochemicals
of the finest purity
at the lowest prices.

*Standard Operating
Procedure



SEND FOR OUR FREE MARCH, 1960 CATALOG

FILL OUT COUPON AND MAIL TODAY FOR YOUR COPY.

Name _____ SC

Organization _____

Address _____

City _____ Zone _____ State _____

**NUTRITIONAL
BIOCHEMICALS
CORPORATION**

21010 Miles Avenue.
Cleveland 28, Ohio

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D.C. Second-class postage paid at Washington, D.C., and additional mailing office. Annual subscriptions: \$8.50; foreign postage, \$1.50; Canadian postage, 75¢.

*In the Laboratory . . . where optical quality counts
 . . . the trend is to UNITRON Microscopes*

BINOCULAR PHASE-CONTRAST BMPE \$490

BINOCULAR INVERTED BMIC \$609

POLARIZING MICROSCOPE MPS \$269

BINOCULAR PHASE-CAMERA-MICROSCOPE BU-13 \$1580

Polaroid Land Camera Attachment \$115

STUDENT AUTO-ILLUMINATION MICROSCOPE MSA \$107

STEREOSCOPIC MICROSCOPE MSHL \$267

MICROSCOPE LAMP LS \$14.75

Attachable Graduated Stage GR \$31.50

Photomicrography Set ACA \$39.95

LABORATORY MICROSCOPE MLK \$198

BINOCULAR AUTO-ILLUMINATION BMLU \$425

FREE 10 DAY TRIAL ON ANY UNITRON

UNITRON offers an extensive line of Laboratory Microscopes & Accessories for Research, Industry and Education. Illustrated is a partial selection for biology, medicine, chemistry and related fields. UNITRON also has companion instruments for the metalworking industries.

Noted for optical quality . . . advanced optical and mechanical design . . . unique and convenient operational features . . . long wearing construction . . . attractive budget prices which include basic optics . . . these, together with years of proven instrument performance, are the reasons why . . .

THE TREND IS TO UNITRON!

UNITRON

INSTRUMENT DIVISION OF UNITED SCIENTIFIC CO.
 204-206 MILK STREET • BOSTON 9, MASSACHUSETTS

Please rush UNITRON's Microscope Catalog 4A-3

Name

Company

Address

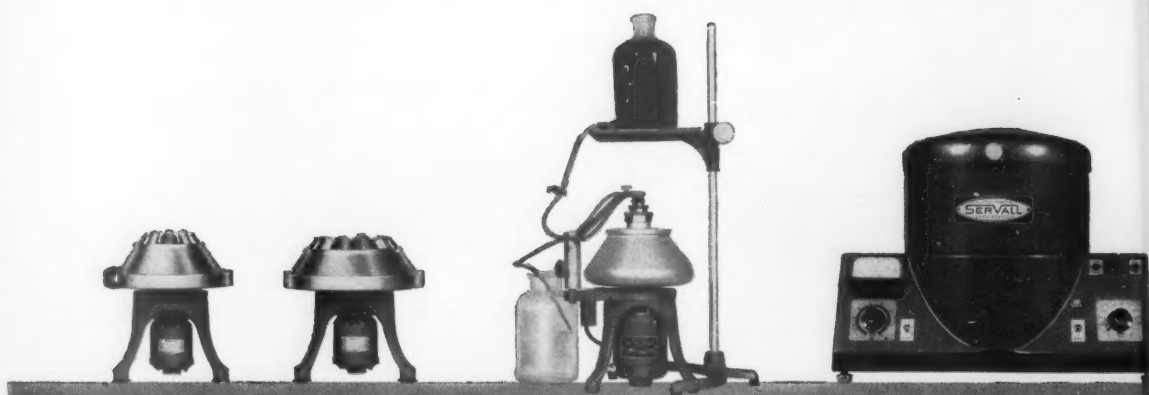
City State

Editorial	Space Exploration as Propaganda	799
Articles	Some Prehistoric Connections between Siberia and America: <i>J. B. Griffin</i>	801
	The intercontinental cultural resemblances can now be studied in terms of more accurate chronology.	
	Hybrids of <i>Escherichia</i> and <i>Salmonella</i> : <i>N. D. Zinder</i>	813
	The genetic homologies of these bacteria are determined by mating and transduction.	
Science in the News	United States Satellite Launched into Orbit around Sun	815
Book Reviews	K. M. Panikkar's <i>The Afro-Asian States and Their Problems</i> , reviewed by <i>W. H. Kraus</i> ; other reviews	820
Reports	Gold-198 Wires Used To Study Movements of Small Mammals: <i>S. V. Kaye</i>	824
	Gibberellin-Induced Inhibition of Bud Development in Some Species of <i>Prunus</i> : <i>M. V. Bradley</i> and <i>J. C. Crane</i>	825
	The Sun Azimuth Compass: One Factor in the Orientation of Homing Pigeons: <i>K. Schmidt-Koenig</i>	826
	Adaptation of Cardiac Output to Peripheral Runoff Studied in Intact Dogs: <i>H. P. Pieper</i>	828
	Primary Site of Gene Action in Anterior Pituitary Dwarf Mice: <i>R. L. Carsner</i> and <i>E. G. Rennels</i>	829
	Heterogeneity of Ion Exchange Resins: <i>M. G. Suryaraman</i> and <i>H. F. Walton</i>	829
	Zinc-65 in Cyclotron Workers: <i>M. A. Van Dilla</i> and <i>M. J. Engelke</i>	830
	Laminarase of <i>Euglena gracilis</i> : <i>J. Fellig</i>	832
Departments	Letters from <i>J. W. Berg</i> and <i>H. F. Blum</i> ; <i>R. Björnerstedt</i> et al.; <i>A. N. Tsvetikov</i> ; <i>K. E. Boulding</i> ; <i>B. D. Thomas</i> ; <i>R. C. von Borstel</i> and <i>E. F. Knipping</i>	796
	Program of the Gordon Research Conferences	833
	Forthcoming Events; New Products	845
Cover	Aurora, taken at the Ballaines Lake field station of the Geophysical Institute, University of Alaska, in mid-April 1957. The structures in silhouette are dipoles of the institute's radio telescope. Exposure, 5 seconds. [V. P. Hessler]	

right across the board.



CENTRIFUGES



Small & Medium Centrifuges
5 rotors on one base

SS-1 Superspeed with Con-
tinuous Flow

SS-3 Automatic Superspeed
17,000 rpm — 34,800 x G

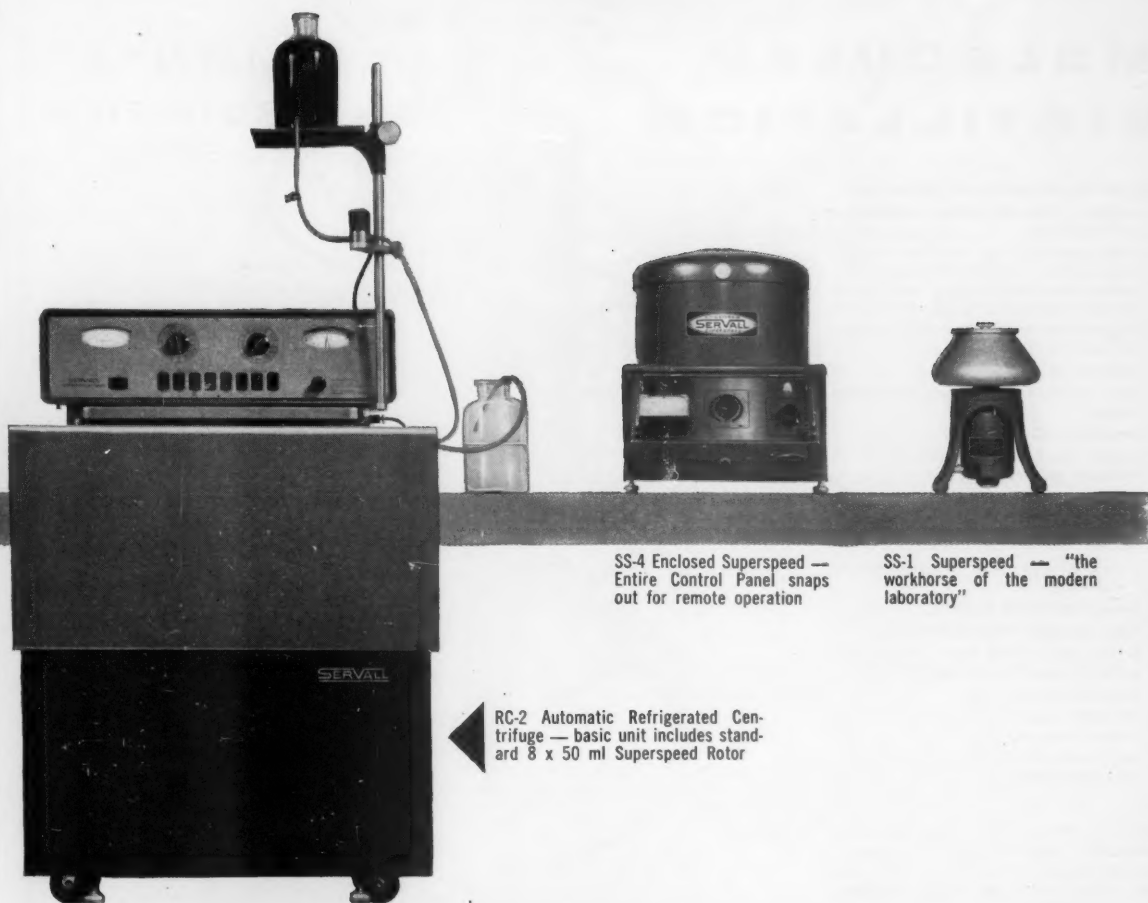
From the SERVALL Small and Medium Centrifuges that offer five different rotors on one basic motor assembly plus a huge variety of tube combinations, to the RC-2, the latest in Refrigerated Centrifugation, SERVALL Centrifuges Serve You Best.

The SERVALL SS-1 Superspeed, SS-3 Automatic Superspeed, SS-4 Enclosed Superspeed and RC-2 Automatic Refrigerated Superspeed Centrifuges, all designed to accept the unique SERVALL 8 to 2 Tube Direct Sedimentation Continuous Flow System, lead the field in a *functional versatility* that is determined by one thing: the modern researcher's requirements — *your* requirements.

Automation, special rotors such as particle counting and field-aligning, high centrifugal force, safety features, operational reliability and simplicity, whichever is *your* major concern SERVALL specifications cover it.

And remember, in the U.S. you get direct, personal service on all your needs from SERVALL-trained representatives. In Canada and elsewhere SERVALL Centrifuges and Instruments are available from specially appointed distributors.

RESERVE YOU BEST!



SS-4 Enclosed Superspeed —
Entire Control Panel snaps
out for remote operation

SS-1 Superspeed — "the
workhorse of the modern
laboratory"

RC-2 Automatic Refrigerated Cen-
trifuge — basic unit includes stand-
ard 8 x 50 ml Superspeed Rotor

ILLUSTRATED LITERATURE UPON REQUEST FOR CATALOG SC-3GC—or circle number on reply card

Ivan Sorvall, Inc.

Norwalk, Connecticut

An independent company; not connected with any other centrifuge manufacturer. Established 1934.

now, at low cost, the new
 ASCO "50" enables you
 to compare your present
 processing costs
 with those of

MOLECULAR DISTILLATION

With this simple-to-operate still you may...

- explore falling agitated film evaporation and distillation,
- distill materials with molecular weights ranging from 200 to 1250 weight (hydrocarbons) and some materials to 4000 molecular weight (silicones and halocarbons),
- deglycerinate and distill mixtures of mono-, di- and tri-glycerides
- distill tall oil
- distill paraffin from slack wax or petroleum residue
- deodorize oils,
- remove color bodies from materials of high molecular weights.

FEATURES

- Batches from 10 ml to 20 liters
- Vacuum range from atmospheric to 1 micron Hg.
- Temperature range to 450°C.
- Teflon or carbon rotor-wiper blades
- Stainless-steel (18-8 type 304) wiper-holders (Available with Hastelloy B)
- Continuous or batch feed
- All parts made of glass except wiper-holders and top plate
- UNITS MAY BE COUPLED FOR FRACTIONATION.

Fields of investigation heretofore made prohibitive through use of highly expensive investigative techniques can now be explored with this simple-to-operate molecular still. Since the "50" still is the laboratory counterpart of the large commercial Rota-Film Still, results obtained may be duplicated on a commercial scale of any magnitude.

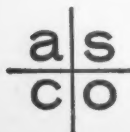
ASCO "50"
 ROTA-FILM
 STILL

*Hundreds
 now in use!*

*Write for folder
 for more details
 and description*

COMPLETE FOR ONLY **\$391⁰⁰**

Write: Dept. S-318



ARTHUR F. SMITH CO. • 311 ALEXANDER ST., ROCHESTER 4, N. Y.



Don't Shortchange The Student!

The school and college laboratory is the training ground for budding scientists. It is in school that they learn the fundamentals which they carry throughout their entire lives. It is in school that they formulate the thought processes which they put to good use in the years following graduation.

Because of the importance of this training, no school or college will offer students an inferior textbook or an incompetent instructor. The best is none too good for the scientist of tomorrow!

Similarly . . . the best in laboratory equipment is none too good for today's scientific student. Unfortunately, there is available in this field, laboratory glassware which is known as the "second", or "school" grade of well-known manufacturers.

Don't cheat your students of the opportunity to work with the best available laboratory glassware . . . especially when you can buy it cheaper than some of the "inferior" grades. Specify Diamond D and be sure of the best. For the complete story of Diamond D manufacture write today for our booklet "Behind The Diamond D" Doerr Glass Company, Vineland, N.J.



OL' NANTUCKET WEATHER GLASS

Here is a hand-blown replica of the weather glasses used on the square-rigged sailing ships that rounded Nantucket Light more than a century ago. It is a crystal-clear pear-shaped pendant which hangs on a 10 1/4" long wrought iron bracket. Fill the glass with water according to directions; chart shows how to translate movement of water in spout in terms of weather forecasts. Ideal for home, office, den, recreation room, college dorm or classroom. \$3.95 postpaid. Doerr Glass Specialties, Inc., Vineland, N.J. Offer good only in continental U.S. and Canada.

Diamond D Laboratory Glassware

Quality Begins With Price And Ends With Performance



MICROFIX*

THE NEW
Plastic filing frame
for micro slides



* U.S. and foreign patents

MICROFIX—A flexible and unbreakable plastic frame which securely holds 12 standard microscope slides and is unequalled for compact storage, group display, and adding information to preparations.

ADVANTAGES

- Slides easily removed and interchanged.
- Ideal for subject groupings and comparisons.
- Stored flat or vertically in any available space—2200 slides on a 36-inch shelf.
- Filed on shelves, in cabinets, in fitted boxes, on plastic racks, in loose-leaf books.
- Available with hooks for display or suspension in racks.
- Dimensions: 6 15/16" x 7 5/16" x 3/16".
- Each Microfix frame separately boxed.
- Microfix equipment includes frames, with and without hooks, covered racks, file cabinets, clip-on metal indexing tabs, etc.

BULLETIN 262

MICRO
IMMUNO

ELECTROPHORESIS ON



AGAR

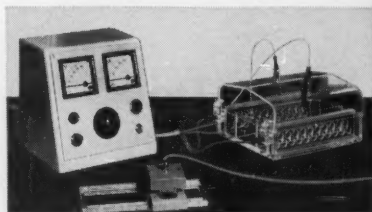
AGA FOR

THE PROCESS

- Complete electrophoretic separations in 45 minutes.
- Average sample size 0.001 ml, resulting in sharpest zones with minimum diffusion.
- Immunological reactions observable immediately following electrophoresis.
- Pattern may be inspected and photographed throughout processing.

THE APPARATUS

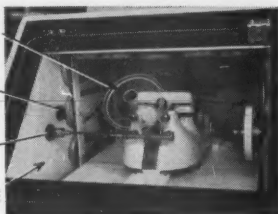
- Designed for use with standard microscope slides.
- Eight patterns obtained in a single run with one cell, 24 with three cells on same power supply.
- Only commercially produced micro and immunoelectrophoresis apparatus complete with cell, power supply, agar cutter, humidifying units, viewer, and Microfix pattern holders.



BULLETIN 257

PORT WINDOW
FOR REMOVAL
OF SECTIONS

ORIFICE FOR
CO₂ JET
ANTI-ROLL
CONTROL
HINGED LUCITE
BAFFLE



From fresh tissue to mounted stained sections in 10 minutes

FEATURES

- Cuts sections down to 4 microns.
- Serial sections cut at 8 microns.
- Entirely remotely controlled.
- Thermostatic control between -5° C. and -30° C.
- For ultra-thin sections and friable tissues knife blade cooled to -50° C.
- Cuts freely at all temperatures; will not rust.
- Instant availability for rapid biopsies.
- Low initial cost and minimum operating attention.

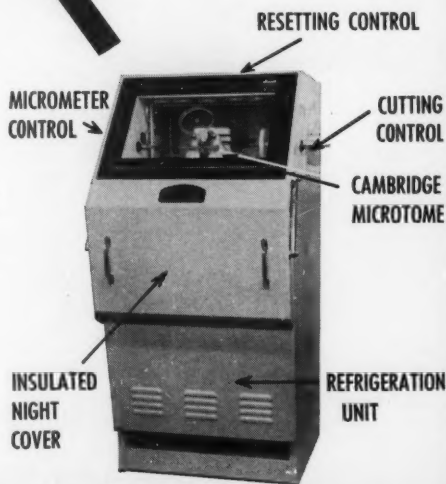
BULLETIN 259

CRYOSTAT

THE PEARSE COLD MICROTOME

The Only Refrigerated
Microtome
With All External Controls

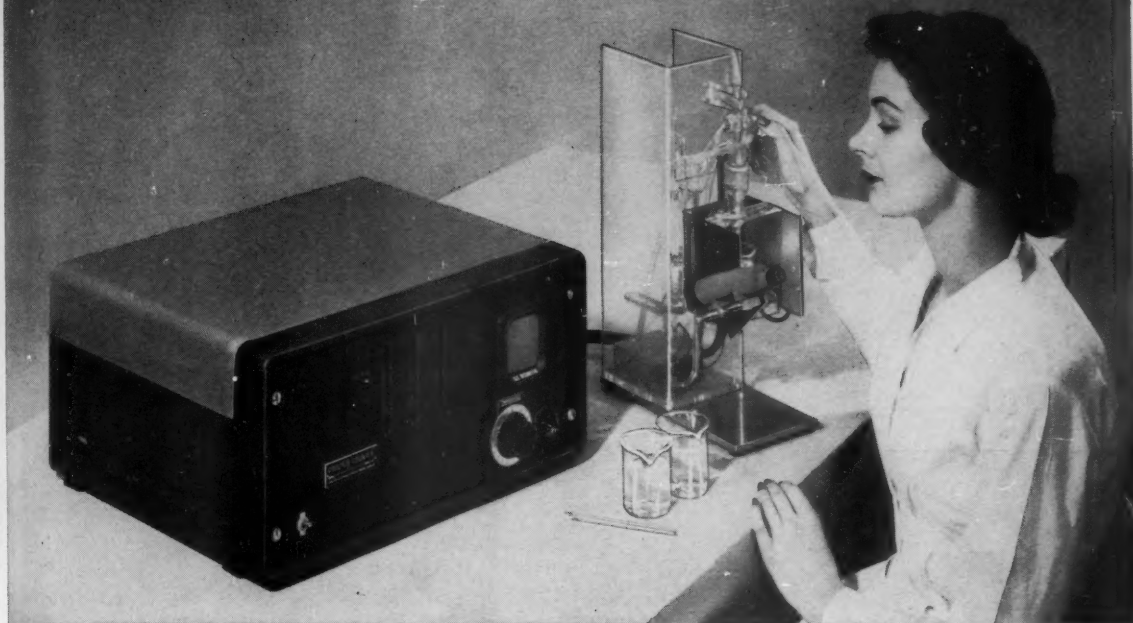
Now assembled and serviced by
N.I.L. for distribution in the U.S.A.
and Canada



NATIONAL INSTRUMENT LABORATORIES, INC.

828 EVARTS STREET, N.E. WASHINGTON 18, D.C. NOth 7-7582

Save time... Increase accuracy



COULTER BLOOD CELL COUNTER

Procedure: Only a few lambdas of blood are required for a test. Sample is mixed with appropriate diluents for red or white counts. After sample beaker is placed in position, operation of stopcock and counting switch automatically cycles instrument. Number of cells appears on counter. After recording count you're ready to go on to the next sample.

For full details consult your S/P representative or write Technical Service Department, Scientific Products, 1210 Leon Place, Evanston, Illinois.

NOW... make red and white blood cell counts electronically, eliminate tedious and time-consuming visual counts.

Get accurate and reproducible results every time with the Coulter Blood Cell Counter. The average count includes 50,000 cells—equivalent to 100 visual chamber counts. Successive readings on a sample agree within 1%. Cell counts are completed in 25 seconds, plus sample dilution time.

Operation of the Coulter system is based on electrical conductivity differences between blood cells and common diluents. This principle permits individual cells to be counted as measured volume of solution is drawn through small electrically-activated orifice. Relative cell size distribution is shown on oscilloscope screen and threshold control makes possible accurate plots of this distribution.

No. 51695A—Coulter Blood Cell Counter.....\$3,550.00

S/P

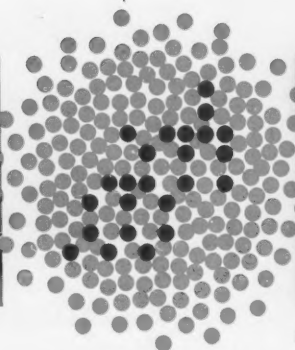
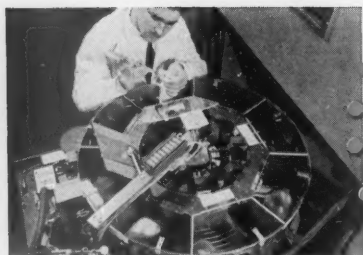
Scientific Products

DIVISION OF AMERICAN HOSPITAL SUPPLY CORPORATION
GENERAL OFFICES—1210 LEON PLACE, EVANSTON, ILLINOIS

Regional Offices: Atlanta • Boston • Chicago • Columbus • Dallas • Kansas City • Los Angeles • Minneapolis
New York • San Francisco • Washington

A Statement from Francis C. Brown, Chairman of the Board and President, Schering Corporation

*"In behavioral research alone, our
Burroughs computer has multiplied
our productivity by 100 times!"*



Dr. Francis Mechner checks computer's daily results with Ronald Ray.

"We, at Schering Corporation, have grown accustomed to miraculous developments in our industry. So many advancements have been made in pharmaceutical research in the last two decades, we are convinced that we may indeed be on the brink of a pharmacological revolution.

"Yet, there is so much more to be done, so many new avenues to explore, that we recognize the only real source of continued development is through expanded research efforts. Through research, Schering has already created several of the world's leading ethical drugs...major emphasis has been on cortical hormones and antihistamines. Some, like Coricidin, have become household words.

"While the results of research are sometimes dramatic, there is little of the miraculous in the day-to-day explorations made by pharmaceutical scientists.

For one thing, pharmaceutical research is expensive...costs are over three times more per sales dollar than all other industries and rising substantially each year. Findings are often inconclusive and only a small portion ever reach fruition in a marketable product. And with a diversified line of products such as ours, we must maintain research projects in many different areas simultaneously. Even with the newest and most successful discovery, a competitor may enter the market with a better product that puts yesterday's 'miracle' out of favor.

"Yet, a relentless search for new products is a necessity. It is the only reasonable assurance of the continuing health of our own business enterprise. Today we are conducting extensive experimentation with chemical molecules of known pharmacological properties. The object is to achieve radically new pharmacological results by means

of various alterations in chemical structure. Once achieved, these new compounds must be evaluated in laboratory animals. The methodology of this program is exemplified by an experiment carried out in Schering's Behavioral Research Laboratory. Here, eight highly trained rats take their turn in succession night and day, at a testing station where their behavior is recorded and then analyzed by computer. This is the type of experimentation in which the behavioral effects of drugs are tested in animals. The results of these experiments permit predictions concerning the effects these drugs will have on man.

"With thirteen experiments of this type proceeding on a continuous basis, the volume of data generated could never be handled without the aid of a computer. The Burroughs 205 performs computations every day which the staff

poration

our

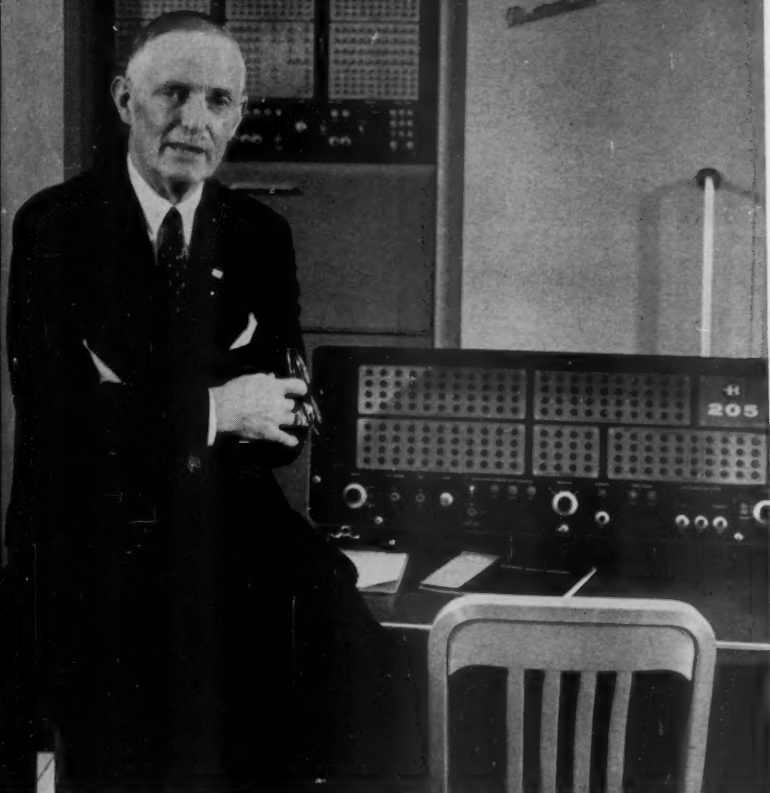
lied

es!"

Donald Ray

chemical
ese new
in labo-
ology of
l by an
Schering's
y. Here,
their turn
at a test-
avior is
by com-
rimenta-
ffects of
e results
edictions
ugs will

of this
is basis,
d could
aid of a
performs
the staff



PHOTOGRAPHS BY J. ALEX LANGLEY



Dr. Bradley Whitman, Director of Research Services, confers with Gordon B. Thomas, Biometrics Manager.

of Schering's Behavioral Laboratory would require years to complete. The computer's final output is in the form of tables and graphs which are then studied and interpreted by psychopharmacologists.

"The decision to install a Burroughs 205 computer was upheld by a need to provide rapid, complete and economic analysis of the data which is produced by the research division at great cost. We investigated the computer field thoroughly, and after careful study and professional consultation, our technical people believed no other computer met our requirements so well. One of our scientific programmers, Biometrics Manager Gordon B. Thomas, was particularly impressed with the 205's ability to handle large masses of data with the power of a large scale computer... and at less than half the cost. Mr. Thomas felt the 4000-word memory of

the 205 greatly facilitated the execution of research programs, many of which exceed 10,000 steps.

"In our research projects alone, the 205 has earned its keep. Dr. Bradley Whitman, head of Research Services, reports our 205 computer is turning out fast, accurate results at a cost we could never have realized by any other method. Research scientists are freed from time-consuming data collecting and may now spend more time on creative work.

"In addition to serving as a research aid, our 205 has provided us with other benefits as well.

"Our Procedures Department Mana-

ger, William B. Spencer, points out that the 205 is completely compatible with our commercial needs as well as research. In fact, our recent purchase of additional Burroughs peripheral equipment will allow us much greater capacity for commercial applications.

"As we expand and broaden our search for new products, we expect commensurate growth in other areas of our company as well, and we are confident that our 205 computer, with its modular expansion features, will keep pace with our computing needs."

FRANCIS C. BROWN
Chairman of the Board and President
Schering Corporation

Hundreds of other scientific and commercial users of Burroughs computers are confirming the same experience. Burroughs complete line of electronic data processing equipment is backed by a coast-to-coast team of computer specialists, all eager to tell you how Burroughs can help in your business. For additional information, write ElectroData Division, Pasadena, California.

Burroughs Corporation

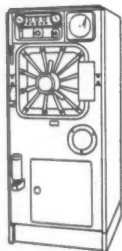


"NEW DIMENSIONS/in electronics and data processing systems"

Today's most efficient still is today's most compact still . . .



Castle **STERIL-AQUA®**



Write, too, for details on Castle's new Orthomatic Steam and (shown above) Sterox - O - Matic Ethylene Oxide Gas Sterilizers.

Here's a new water distillation process for industry that offers you greater efficiency in $\frac{1}{3}$ the space of conventional units!

The Castle STERIL-AQUA produces pyrogen-free water direct from boiler steam . . . and at less cost than any other still. It requires less steam, radiates less heat, and needs far less maintenance.

Most important, STERIL-AQUA operates consistently at or above rated capacity and produces distillate of purity equal to or surpassing USP XV standards. Models from 5 to 500 gph. Call your Castle dealer or write for full details.

Castle **LIGHTS AND STERILIZERS**
WILMOT CASTLE CO., 1713-3 E. HENRIETTA RD., ROCHESTER 18, N. Y.

COLEMAN



Most important advance in 50 years

AUTOMATIC NITROGEN ANALYSIS

*Micro-Dumas Method
with digital readout*



Nitrogen Analyzer

Eminently practical for any laboratory, this new instrument combines a refined classical Micro-Dumas method and full automation. Instrumental versatility additionally permits use in certain Kjeldahl applications.

Nitrogen determinations at the rate of 4 to 5 per hour—up to 40 per day—are routinely afforded with an instrument requiring only 18" of bench space.

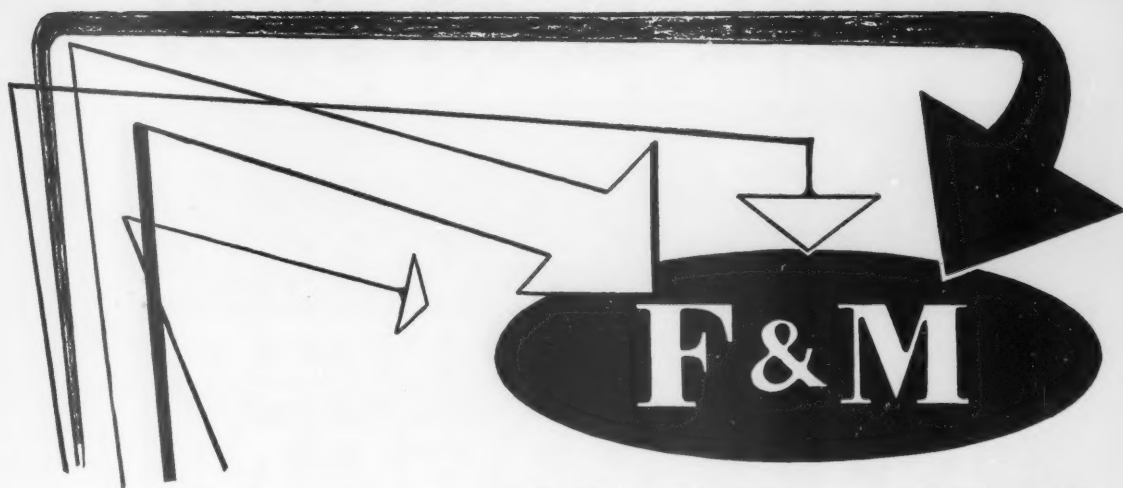
These outstanding features bring nitrogen analysis up to date:

- Fully automatic
- High analytical accuracy
- Digital readout of nitrogen volume
- Efficient, miniaturized absorption chamber
- Flexible combustion cycles accommodate a variety of sample weights and materials
- Low-cost disposable sample boats

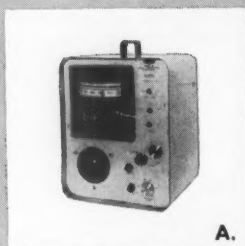
For complete information, write for Bulletin SB-258.

Order and simplification are the first steps toward mastery of any science

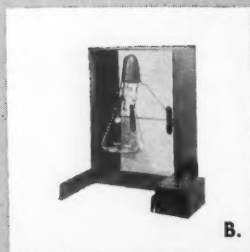
COLEMAN INSTRUMENTS, INC., MAYWOOD, ILLINOIS



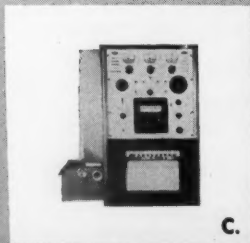
INTRODUCES THE FOLLOWING LINE FOR GREATER ANALYSIS COVERAGE . . .



A.



B.



C.

A. Model 40 Linear Temperature Programmer featuring 13 heating rates from 0.8 to 44.3°C. for linearly increasing the temperature of heating equipment. Write for Brochure 40.

C. Revolutionary Model 202 Linear Programmed Temperature Gas Chromatograph for analyzing wide boiling mixture. Write for 15 page report.

E. Gas Chromatographic Accessories maintained in stock include Disc Integrators, Hamilton Syringes, M-H and L & N Recorders, Flow-meters, Collection Systems, etc.

B. Model 141 Safety Ignition Unit — Schöniger Oxygen Flask for decomposing organic halides, sulfur, phosphorus and various metals prior to analysis. Write for brochures.

D. Specialized Gas Chromatographic Packings, solid supports and liquid phases for determination of water, acids, and other polar materials.

✱ Write for Free Subscription to F & M's new Technical Bulletin, "Facts & Methods for Scientific Research".

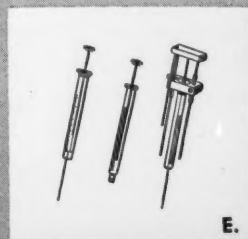


F & M SCIENTIFIC CORPORATION

1202 ARNOLD AVENUE, N. C. COUNTY AIR BASE
NEW CASTLE, DELAWARE • PHONE EA 8-6606



D.



E.

ADVERTISING PAGES 767-768 ARE MISSING



Sodium Tungstate

POWDER

Na₂WO₄ · 2H₂O

Completely conforms to Dr. Folin's Specifications F. W. 329.934

'Baker Analyzed' REAGENT

FOR LABORATORY USE ONLY

ANALYSIS OF LOT NO. 20082

MEETS A.C.S. SPECIFICATIONS

Assay (Na ₂ WO ₄ · 2H ₂ O)	99.3	%
Insoluble Matter	0.004	%
Alkalinity (as Na ₂ CO ₃)	0.10	%
Chloride (Cl)	0.0001	%
Nitrogen Compounds (as N)	0.0005	%
Sulfate (SO ₄)	0.002	%
Arsenic (As)	0.0003	%
Heavy Metals and Iron (as Pb)	0.0005	%
Molybdenum (Mo)	0.0002	%

Ref. Folin's Manual of Biological Chemistry, 5th Edition, Journal Biological Chemistry, Vol. 106, No. 1, Page 311 (1934).

STORAGE: Keep in well-closed containers.

J.T. BAKER CHEMICAL CO., PHILLIPSBURG, N.J.

On your clinical laboratory team—

'Baker Analyzed' Reagents

with the highest purity in the industry

In hospital work, your clinical laboratory team needs dependable purity, accurately defined purity—more than just purity within a range

The purity of 'Baker Analyzed' Reagents is not only the highest in the industry, but it is purity defined right on the label. Each label provides *actual lot analysis* with significant impurities defined to the decimal. On more than 300 'Baker Analyzed' Reagents, purity is also defined on the label by *actual lot assay*.

No wonder hospital chemists, technologists, and buyers prefer 'Baker Analyzed' Reagents. They know that Baker's published standards of purity are the most stringent in the industry. They know they can buy this well defined purity at no price premium.

Hospital buyers also know that Baker has one of the most complete and progressive lines of reagent chemicals—almost one thousand items modernly packaged for convenient, safe handling as well as compact storage.

Ask your supply representative

Baker laboratory chemicals are quickly available from leading supply houses in each marketing area. Ask your Supply Representative to explain *all* the reasons why 'Baker Analyzed' Reagents perform more efficiently in hospital laboratories. He's an expert in the field of laboratory supply, hand-picked for his job, well-trained, experienced and able. Call him when you have a problem. He's a good man to know better!



FREE SPECIFICATION CATALOG

...contains complete information about 'Baker Analyzed' Reagents and other chemicals, including pricing and packaging data, formulas, formula weights and specifications. May we send you a copy?



J. T. Baker Chemical Co.
Phillipsburg, New Jersey



The Cooke M15 . . . a laboratory microscope with superior optical performance. Its clean design and precision construction offer unequalled convenience, versatility and durability.

Manufactured at York in England . . .

specifications on all models available on request . . .

Model BZ2L, illustrated above, 30X to 1000X, F. O. B. Boston, \$525.

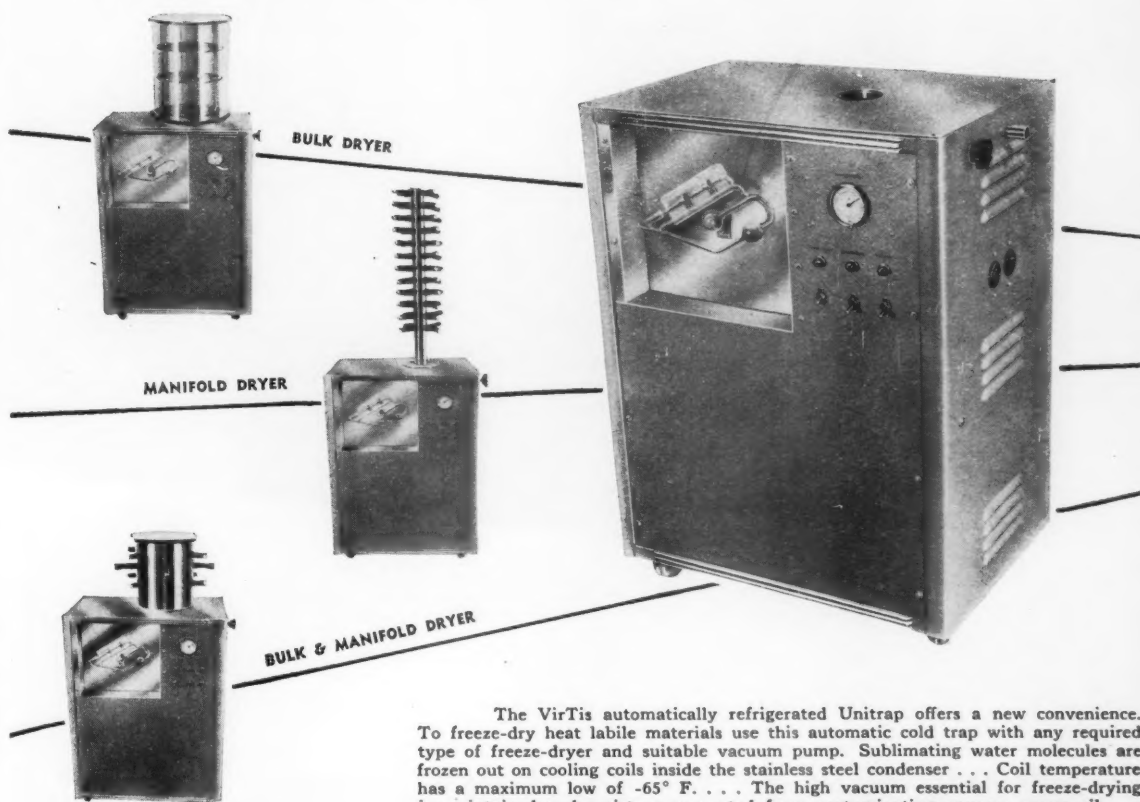
COOKE TROUGHTON & SIMMS, INCORPORATED

91 WAITE STREET, MALDEN 48, MASSACHUSETTS • IN CANADA: 77 GRENVILLE STREET, TORONTO

The 'Heart' of your Freeze-Drying System

the new UNITRAP

- One automatically refrigerated cold trap for all freeze-drying procedures.
- Freeze-dry on manifolds or electrically heated trays.
- Three liter effluent capacity per dehydration.
- Eight different vacuum drums available.
- Economical conversion of present equipment to automatic refrigeration.



The VirTis automatically refrigerated Unitrap offers a new convenience. To freeze-dry heat labile materials use this automatic cold trap with any required type of freeze-dryer and suitable vacuum pump. Sublimating water molecules are frozen out on cooling coils inside the stainless steel condenser . . . Coil temperature has a maximum low of -65°F. . . . The high vacuum essential for freeze-drying is maintained and moisture prevented from contaminating vacuum pump oil.

The eight different vacuum drums available for use with Unitrap represent three different types . . . For bulk processing only; for drying samples connected to a manifold; and combination bulk and manifold drying chambers. An electrically heated three tray rack is supplied for bulk drying procedures. These trays yield an even heat input to each sample, assuring uniform drying rates.

The VirTis Unitrap provides maximum safety for high vacuum studies . . . (no glass used except in the fabrication of the vacuum gauge.) Because a high degree of drying efficiency is routinely obtained, the Unitrap is suitable for precise freeze-drying studies to relate to production schedules, as well as for routine laboratory operations.

Switch your present dry ice cooled instruments to automatic refrigeration. The VirTis Micro, Macro, Super, Large Port, Forty Port, or Bio-Dryer Freeze-Dryers are easily and economically converted to the modern convenience of the Unitrap.

For full information on automatic freeze-drying write —

THE VIRTIS CO., INC. -- GARDINER, N. Y.



NEW!

Bausch & Lomb
SPECTRONIC 505*
Recording Spectrophotometer



\$3685 **VISIBLE RANGE**
(UV - VISIBLE, \$4285)

*...less than half the cost of other
recording spectrophotometers!*

See the revolutionary new instrument that directly records transmittance, absorbance, reflectance and emission in UV and visible ranges...

with an exclusive electronic sensor that automatically adjusts drum speed to variations in curve complexity...

featuring B&L Certified-Precision Gratings.

Only 36" x 22" x 15", it's as streamlined as the universally accepted B&L Spectronic 20* Colorimeter...

with a complete line of accessories including an exclusive new air-cooled Hydrogen lamp...

at less than half the cost of other recording spectrophotometers.

*Trademark, Bausch & Lomb Optical Co.

BAUSCH & LOMB



Write for your copy of Catalog D-2009, Bausch & Lomb Optical Co., 75903 Bausch Street, Rochester 2, N. Y.



TELEVISION



MICROSCOPE

CONSIDER THE APPLICATIONS OF THIS NEW **ZEISS-SIEMENS** ACHIEVEMENT

The new Zeiss-Siemens Television Microscope is the first integrated closed circuit TV system developed specifically for use with the microscope. It was designed for maximum operator convenience — simplified controls and compact construction.

The optical components are intended for use with the microscope stand WL, but can on demand be adapted for use with other stands such as the Zeiss automatic photomicroscope. All electronic accessories are manufactured by Siemens. The latter are unique in offering unsurpassed

resolving power through the use of a scanning system of 625 lines per frame. An automatic gain control maintains a constant level of light intensity on the viewing screens.

We suggest the following applications for the TV microscope:

- Projection of slides at very high magnifications in both brightfield and phase contrast.
- Instructional purposes such as medical school classes.

- Semi-qualitative micro-spectrophotometry.

- Closed circuit systems in hospitals between pathology and operating units.

- Distant observation of material under controlled atmospheres and/or conditions which endanger the observer.

- Microscopy outside of the visible range.

For complete detailed information, request pamphlet 40-380/1-E.

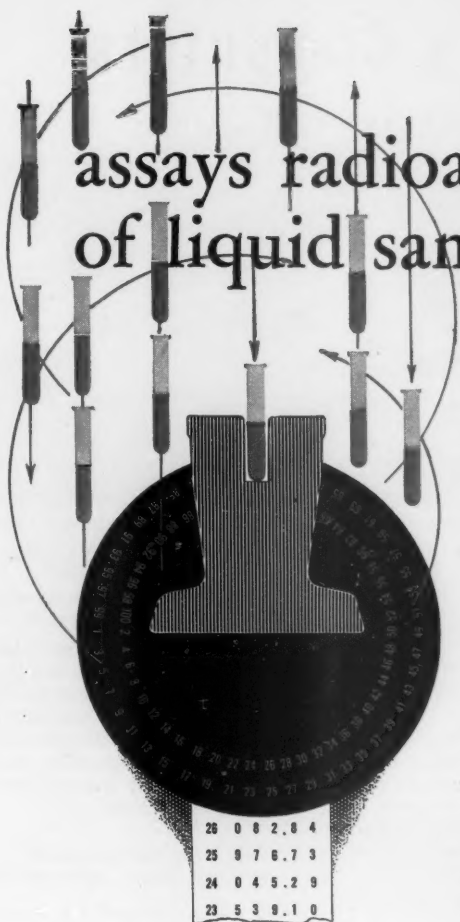
BRINKMANN

BRINKMANN INSTRUMENTS, INC. 115 CUTTER MILL ROAD, GREAT NECK, N. Y.

Offices in: Phila., Cleveland, Houston, Miami.

assays radioactivity of liquid samples

*up to a hundred at
a time automatically
with accurate count printout*



Here's the way to save hours and days in laboratories handling large numbers of radioactive liquid samples (or smaller numbers, maybe, of low-activity samples which count slowly). Answers the kind of problem that arises, for example, in human blood studies with Iron⁵⁹ or in metabolic studies on test animals.

Some of its unique features ...

Handles 100 15 cc samples

Samples always accessible

Uses virtually any well-type scintillation detector

Operates with Picker Count-and-Time Printer or Printing Timer

Constant background count because samples surround the detector uniformly

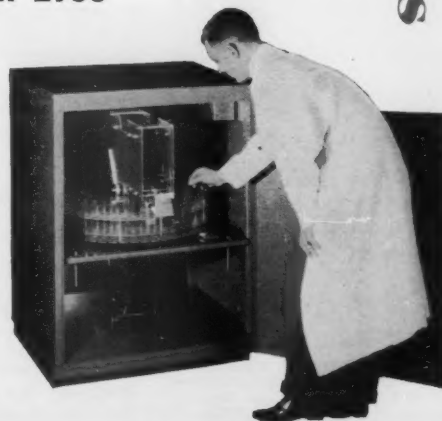
Modest cost \$2,000.00

spare hours — save the day — with the

PICKER AUTOMATIC WELL COUNTER 2956

This unique instrument is one of the comprehensive Picker family of quality nuclear equipment. The line includes instrumentation for every phase of diagnostic and therapeutic use of radiosotopes.

For particulars, call any Picker District Office —there's probably one near you (see your local 'phone book). Or write Picker X-Ray Corporation, 25 South Broadway, White Plains, New York.



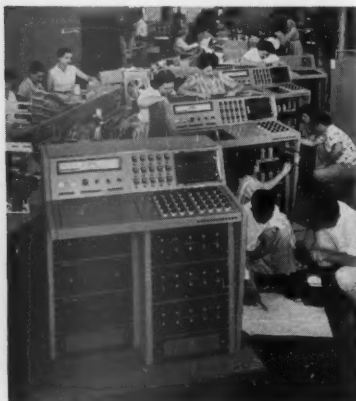
What you should know about Analog Computers

Judging from the literature, most discussion of analog computers turns on form rather than function.

Every computer manufacturer, including Donner, is ready to tell you all about their designs, right down to the last microvolt. Few spend their literary effort in telling you how to use them and what kind of problems are amenable to analog computer solution. Not too strangely, this is what you, the prospective user, wanted to find out in the first place.

HOW AN ELECTRONIC ANALOG COMPUTER SOLVES PROBLEMS

A mathematical expression which defines the dynamic behavior of a particular physical system also describes the behavior of all other analogous systems. A general purpose analog computer can be programmed to behave as one of these analogous systems. So programmed, it can be used to explore the characteristics of the system or to "solve" the describing equations. Typical problems range all the way from explaining the laws of classical and modern physics to the physiological relations of life itself. Here are some of the fields where analog computers are in use: antenna design, medical research, cybernetics, electron trajectories, nuclear reactor design, fluid me-



Assembly of Donner 3100 series high accuracy medium size analog computers in quantity lots provides the user with more value at lower cost. Complete Donner 3100 Computer Consoles start at just under \$11,000.



The Donner 3400 Desk-top Computer functions as a compact, versatile electrical model of a dynamic system.

chanics, heat transfer analysis, aerodynamics, meteorology, classical and nuclear physics, chemical kinetics, petroleum, engineering, servo system analysis, auto- and cross-correlation, and economic forecasting.

Basic computing elements in an electronic analog computer are dc amplifiers, precision components (resistors, capacitors, and potentiometers), and non-linear accessories (multipliers, function generators, and transport delay simulators).

By interconnecting the computing elements at a patchboard, varying voltage amplitudes can be integrated, summed, differentiated, multiplied, divided, altered in non-linear fashion, and otherwise operated on as directed by a mathematical equation. The answer, which appears as a varying voltage, can be visually observed on a voltmeter or an oscilloscope and permanently recorded by any one of several plotting devices.

The analog computer user can take an equation, change the coefficients at will, and get whole sets of solutions with amazing ease and speed. He can get these results to accuracies of 0.1% or better for a very modest investment. Small Donner computers begin at just over \$1,000.

ANALOG OR DIGITAL

The chief advantages of the analog technique are speed, economy, and flexibility. With the analog computer, you get a genuine insight into the response of the system to both internal and external stimuli. No other ap-

proach can bring the investigator into such intimate contact with the system.

Digital computers sometimes provide more accurate results, but they seldom give the user the same knowledge because they are at best only machines that compound arithmetic information. Unlike digital computers, analog computers actually behave just like the simulated systems.

TWO NEW PUBLICATIONS PROVIDE MORE INFORMATION

If you are interested in learning more about the application of analog computers, copies of Donner Tech Notes #1 and #2 are available from your nearby Donner engineering representative or directly from the factory. Tech Note #1 is titled "How to Simulate a Non-Linear Control System with an Analog Computer;" Tech Note #2, "How to Use and Program Analog Computers."

Donner Scientific specializes in the manufacture of accurate fixed and general purpose analog systems designed to analyze, measure, and control dynamic inputs. Complete technical information and informed applications assistance can be obtained from your nearby Donner engineering representative or writing Dept. 98.

**DONNER SCIENTIFIC
COMPANY**

888 Galindo • CONCORD, CALIFORNIA
Phone: MULberry 2-6161

*If you're
reading records manually...
you can do it faster
and at less cost
with Benson-Lehners'
new Oscar K!*



Is your laboratory or test facility getting tangled in a needless time effort in slowly reading, interpreting and transcribing trace records by hand? Here's the answer to your oscillogram and strip chart reading needs; The OSCAR K. *OSCAR K is small*; and in a single console. *OSCAR K is versatile*; it measures trace amplitudes of various sizes and materials — transports records in either direction at variable speeds. *OSCAR K is accurate*; + or — 0.1% of full scale. *OSCAR K is economical*; \$4,990! Find out how much the OSCAR K can save your lab in time and money. Write for complete information.

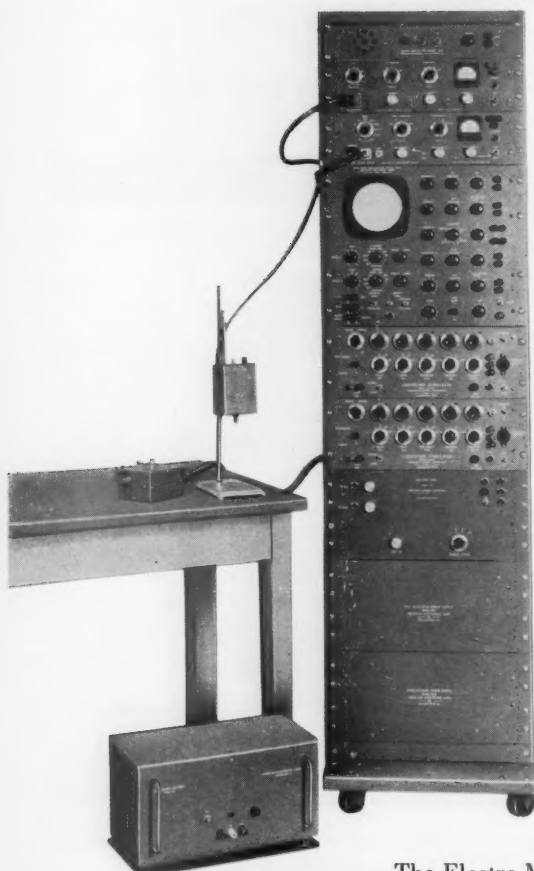


benson-lehner Corporation

1860 Franklin Street • Santa Monica, California

Offices: LOS ANGELES; WASHINGTON, D.C.; DAYTON, OHIO • Service Centers in 28 cities throughout the world.

...for
you
the
Life Scientist
we've
"racked
our
brains!"



See us at Booth #35
Meeting
"Federation of
American Societies for
Experimental Biology"
Conrad Hilton Hotel
Chicago, Ill.
April 11-15

Here is a team of high quality, versatile companion instruments working in unison to help resolve your most difficult problems.

- ▲ AUDIO AMPLIFIERS
- ▲ WIDE-BAND DIFFERENTIAL DIRECT COUPLED AMPLIFIERS
- ▲ WIDE-BAND ELECTROMETER AMPLIFIERS
- ▲ DUAL BEAM OSCILLOSCOPES
- ▲ AEL LABORATORY STIMULATORS
- ▲ EXPANDED SWEEP GENERATORS
(Raster Timer)
- ▲ DUAL REGULATED POWER SUPPLIES
(Medically Designed)
- ▲ ELECTRONIC BATTERIES
(Transistor regulated supply)

◀ AEL is an "Electro-Medical Instrumentation" Company . . . and as such stands ready to serve you whether it be to answer a question or to supply your equipment needs.

The Electro-Medical Instrumentation Research work carried on in our own AEL laboratory is quite extensive, serving the needs of Industry, Government Agencies and Privately Endowed Institutions.

It is in this line of duty that we continue to "Rack our Brains". . . thus guaranteeing our customers the finest in Electro-Medical Equipment available.

AEL AMERICAN ELECTRONIC
LABORATORIES, INCORPORATED

121 N. 7th Street
Phila. 6, Penna.

THE *Mettler* PAGE

DEVOTED TO NEWS ABOUT TRULY MODERN BALANCES



METTLER BALANCE—Type K-7

K-7 units have a capacity of 800 grams and a precision of ± 0.03 g. The K-4 and K-5 models have capacities of 4000 and 2000 g respectively and are precise to ± 0.2 g. All units can be equipped for the weighing of samples suspended below the balance.

Mettler K-SERIES PRECISION SCALES

The METTLER analytical balances brought speed and convenience to the weighing operation and at the same time greater precision and accuracy.

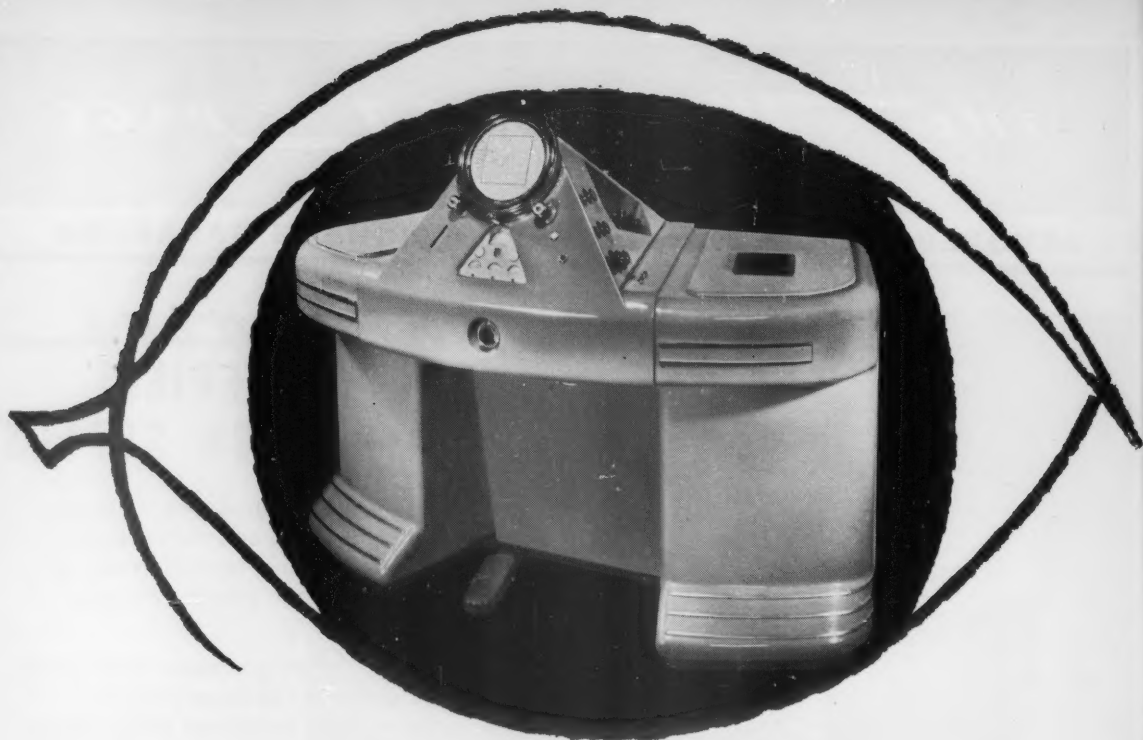
The METTLER precision scales of the K series do the same thing for the routine weighings performed in the chemical laboratory. Their accuracy, speed and flexibility in use are the result of sound design and careful manufacture. The major basic features are:

- a completely unobstructed pan on top of the instrument
- very wide optical range
- mechanical weights built into the unit
- magnetic damping
- a fast and convenient taring system of wide range

All these features are built into a compact and rugged unit requiring less than 10" of front space on the laboratory bench.

Write to us today for full information on the basic units and the many modifications available from stock.

METTLER INSTRUMENT CORPORATION
HIGHTSTOWN, NEW JERSEY



NORELCO ELECTRON MICROSCOPE 100B

In electron microscopy these Philips features constitute obvious design benefits. A new advance in illuminating system offers a coherent electron source. This source maintains the same excellent image resolution found in earlier models, but now provides a noteworthy increase in the relative contrast in the images of thin, frail specimens, whose inherent density variations are not pronounced.

Selective penetration offered by 40, 60, 80 or 100 kilovolts provides a choice by which adequate attenuation of the specimen can be achieved. Another prime feature is the design of the immersion objective lens which provides an unusual facility whereby many desirable physical treatments of the specimen may be made. These include stretching, cooling and heating. It further permits

the introduction of air sensitive hygroscopic materials. Another feature, for example, is the ease of obtaining true-stereo images by simple rotation of the specimen in its own plane.

"Work-horse" characteristics offer greatly minimized downtime and maintenance. Inherent resolution in the EM-100B becomes more meaningful with this new increase in relative contrast. Added to this is the convenience, ease and simplicity of operating the EM-100B; low comparative investment costs; and the exclusive basic design feature which precludes obsolescence since all design modifications and improvements can be added to existing models.

Become convinced that the EM-100B Electron Microscope is unexcelled by any other in the market.



Write today. We will be pleased to send you more data

on this or the smaller EM-75B Electron Microscope.

PHILIPS ELECTRONIC INSTRUMENTS

A Division of Philips Electronics and Pharmaceutical Industries Corp.

750 SOUTH FULTON AVENUE, MOUNT VERNON, N.Y.

In Canada: Research & Control Instruments • Philips Electronics Industries Ltd. • 116 Vanderhoof Ave. • Leaside, Toronto 17, Ont.



Whatever the instrument source . . .

if the reading is convertible into a d-c signal

RECORDALL WILL CHART IT!

Although industry uses a great number of special recording instruments to collect data, the average laboratory cannot afford such duplication. To meet the need, the Fisher Recordall® was developed—the first universal laboratory recorder on the market. The Recordall will chart, as a function of time, *any* instrument reading that can be converted into a d-c signal. It records potential, current, resistance and temperature directly. Transducers are available to enable it to record pressure and vacuum, plot pH changes or draw a polarographic curve.

Direct reading scales, 11 current and potential ranges, wide variety of adapters and accessories . . . these are only a few of the features that make the Fisher Recordall one of the laboratory's most useful and flexible tools.



Write for the 12-page, illustrated booklet on the Fisher Recordall. 139 Fisher Building—Pittsburgh 19, Pa.

B-113



FISHER SCIENTIFIC

America's Largest Manufacturer-Distributor of Laboratory Appliances & Reagent Chemicals

Boston

Buffalo

Charleston, W.Va.

Chicago

Cleveland

Detroit

Houston

New York

Philadelphia

Pittsburgh

St. Louis

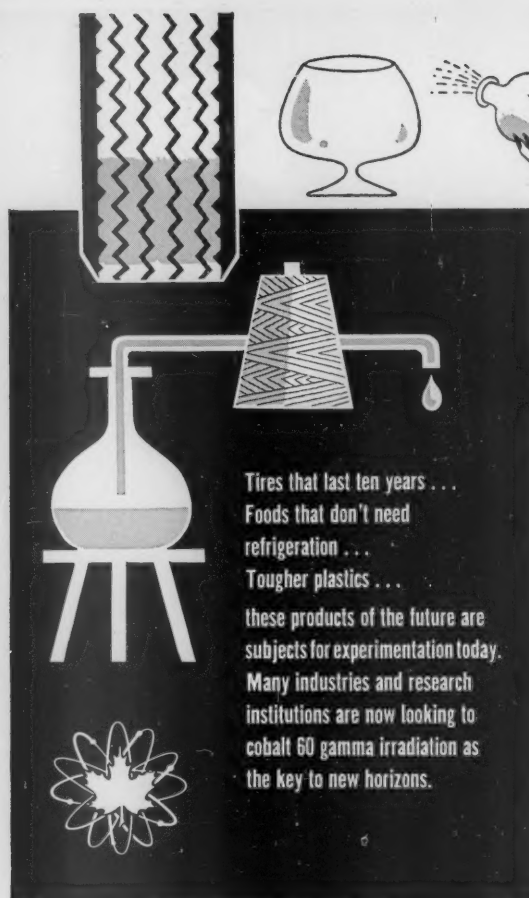
Washington

IN CANADA

Edmonton

Montreal

Toronto



You are cordially invited to visit us at our booth in the CANADA section at the Atomic Exposition, New York City, April 4-7, 1960.



Photo courtesy Textile Research Center, School of Textiles, North Carolina State College, Raleigh, N.C.

For your gamma irradiation experiments, choose the

GAMMACELL 220

with source strengths to suit your purpose

IT'S PROVEN — Already in use in several countries and in many fields of research.

IT'S SELF-CONTAINED — No auxiliary shielding required ... Buy it as just another piece of laboratory equipment. Easy to move to a new location as a change in plans requires.

IT'S SAFE — By construction, it is inherently safe to operate. Overexposure would have to be deliberately planned.

IT'S SIMPLE — No complex electrical equipment to break down. Any technician can readily operate it with minimum instruction.

FOR FULL DETAILS ON THE GAMMACELL 220, KILOCURIE COBALT 60
OR OTHER ISOTOPE EQUIPMENT, PLEASE WRITE TO: —

ATOMIC ENERGY OF CANADA LIMITED

COMMERCIAL PRODUCTS DIVISION

P.O. BOX 93

OTTAWA, CANADA

59-1

SCIENCE, VOL. 131

Now...for the *FIRST TIME!*



SPIN

1,500 ml. to 60,000 x G

3,300 ml. to 33,000 x G

**AUTOMATIC CONTROLLED
TEMPERATURES
DOWN TO
-10° C.**

**NEW
MODEL
VA-2**

**patented*

LOURDES AUTOMATIC ULTRA-SUPERSPEED REFRIGERATED VACUUM CENTRIFUGE

ANOTHER EXAMPLE OF LOURDES'
LEADERSHIP IN OFFERING
EQUIPMENT OF ADVANCED DESIGN
TO MEET YOUR
LABORATORY REQUIREMENTS.

- Automatic rotor acceleration
- Automatic self-centering drive
- Automatic safety interlocks
- Automatic vacuum seal lubrication
- Electro-Dynamic Braking
- Continuous Hi-Vacuum system
- 400 ml. (8 x 50 ml.) at 51,000 x G
- 360 ml. (24 x 15 ml.) at 51,000 x G
- Exclusive *patented* refrigeration design
- 1 Year Guarantee



LOURDES INSTRUMENT CORP.

DIVISION OF LABLINE INC.

53rd Street & 1st Avenue, Brooklyn 32, N. Y.

Kindly send your latest Catalog and Bulletins to:

NAME _____ TITLE _____
INSTITUTION _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

530

783

VICTOREEN

WORLD'S
FIRST
NUCLEAR
COMPANY

TRANSISTORIZED SPECTROMETRY

A DUAL INPUT

TRANSISTORIZED 200-CHANNEL SPECTROMETER

featuring

DIFFERENTIAL DATA ACCUMULATION



TULLAMORE-DESIGNED
MODEL ST-200D. For complete details
write for Victoreen Form 3121-9.

The new VICTOREEN MODEL ST-200D Spectrometer will accept two inputs simultaneously and will add, subtract, or separate the data *during the accumulation process.*

Features

- 200-channel ferrite core memory
- Decimal address and storage—no decoding necessary in printout
- 10^5 counts/channel
- Automatic bi-directional decimal storage
- Parallel data readout
- Printout at 4 channels/second
- 5" CRT display
- Two independent amplifiers and preamplifiers
- Neon digital indicators
- Built-in precision pulse generator
- Memory subgrouping

Applications

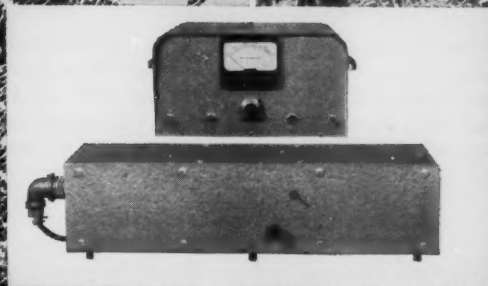
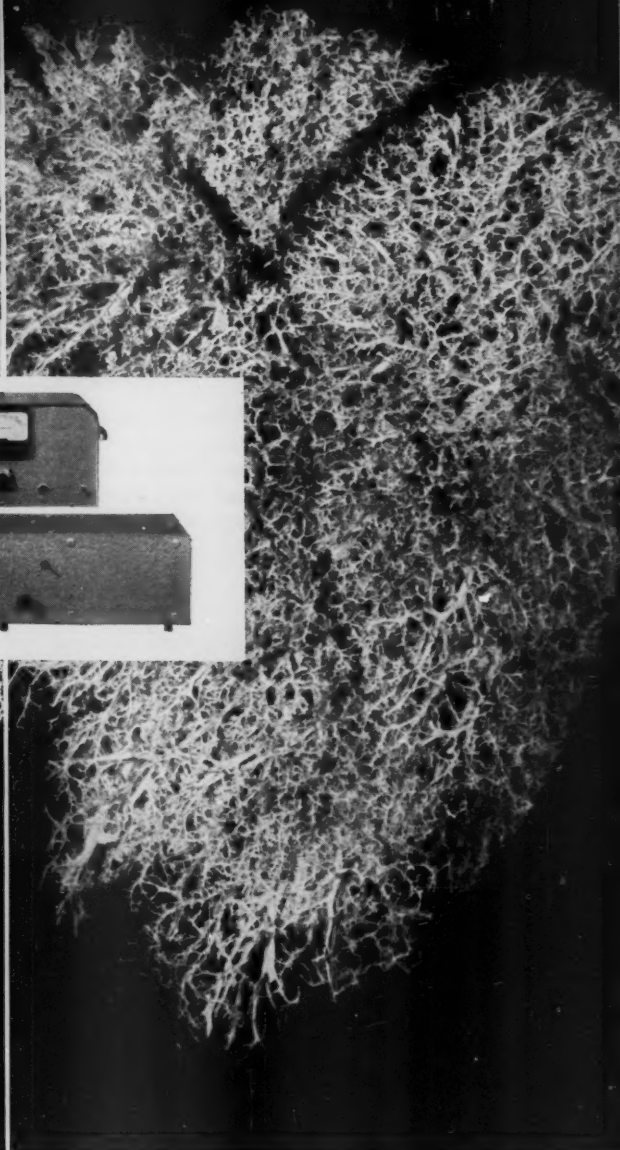
- 4-pi scintillation spectrometry
- "Peel-off" analysis of complex spectra
- Simultaneous background subtraction
- Summation of independent spectra
- Decay scheme studies
- Health physics identification studies
- Whole body counting



The Victoreen Instrument Company

5806 Hough Avenue • Cleveland 3, Ohio
Export Department, 240 West 17th St., New York 17, N. Y.

Cable: TRILRUSH, New York



Dual tool for botanical-physiological research... the Beckman Model 15-A Infrared Analyzer is a versatile instrument of high accuracy, quick response. In photosynthesis studies for sensitive measurements of minute quantities of CO_2 or H_2O ...in clinical medicine for measurements of CO and acetylene in pulmonary diffusion capacity studies...the 15-A has established itself as the standard instrument, because of these important advantages: Response speed of 0.5 sec. to 90%...usable with a galvanometer data recorder...accuracy is $\pm 1\%$ of scale...sensitivity up to 0.1 ppm with full scale ranges from ppm to 100%...choice of window materials and sample cell lengths to suit any analysis...simplified design for continuous operation with minimum maintenance. For information on specific applications, contact your Beckman sales office. Or write today for Data File 38-12-10.

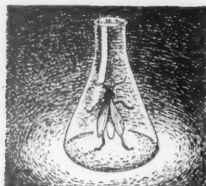
Beckman
Scientific and Process

Instruments Division
Beckman Instruments, Inc.
2500 Fullerton Road, Fullerton, California



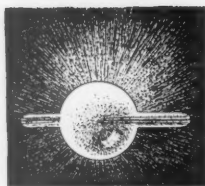
IT HAPPENED THIS MONTH...

a glance at yesterday in relation to today



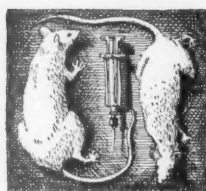
IN MARCH—(1883)—*Science* reviews a German paper on the luminosity of fireflies and states that, "The production of light results from the slow oxidation of materials formed, under control of the nervous system, by the parenchymal cells. The light may continue to shine long after the death of the cells, and therefore is not a property of the living protoplasm as such."¹

Today it is widely recognized that bioluminescence is a property of "high-energy" phosphates. To help researchers throw further light on such phenomena, Schwarz BioResearch supplies both ATP and firefly lanterns—also ADP and AMP. Whether your interest is in studying the role of phosphates in firefly signals or in using firefly tails to measure concentration of ATP, you should have our latest catalog and price list.



IN MARCH—(1906)—Because of increasing interest among medical men in the therapeutic use of radioactive materials, Berg and Welker² reported information they had gathered on the metabolic effects of small doses of radium. Following feeding and injection of radium and barium salts in dogs, analyses of excreta and organs were performed. The main conclusion reached is that very little, if any, metabolic effect can be attributed to radium.

Medical men are still interested in the therapeutic use of radioactive materials and, more recently, in the diagnostic value of radioactive tracers. At Schwarz BioResearch, we prepare S^{35} , C^{14} , H^3 , N^{15} and P^{32} compounds, and offer these compounds for sale.



IN MARCH—(1950)—Hammarsten and Reichard³ report on their investigation of the question of fundamental differences in the metabolism of free pyrimidines and ribose-bound pyrimidine. To start things off, they injected N^{15} -labeled cytidine and uridine into rats. Analysis for N^{15} was carried out on the bases and nucleosides derived from pooled internal organs. It was found that cytidine can be utilized by the rat for synthesis of new polynucleotides, but that the utilization of uridine for the synthesis of polynucleotide pyrimidines is very low and is not very specific.

Schwarz BioResearch has purines, pyrimidines, and a host of other basic biochemicals, with and without radiolabels. Do you have our catalog and price list?

1. ———: *Science* 1:150 (Mar. 9) 1883. 2. Berg, W. N., and Welker, W. H.: Experiments to determine the influence of the bromides of barium and radium on protein metabolism, *J. Biol. Chem.* 1:371 (Mar.) 1906. 3. Hammarsten, E., and Reichard, P.: Pyrimidine nucleosides as precursors of pyrimidines and polynucleotides, *J. Biol. Chem.* 183:105 (Mar.) 1950.



SCHWARZ BIORESEARCH, INC. • Dept. 3B • Mount Vernon, New York

BIOCHEMICALS • RADIOCHEMICALS • PHARMACEUTICALS for research, for medicine, for industry

AUTOMATIC RECORDING TITRATOR

MODEL AT-2A

All potentiometric titrations performed automatically!

- Automatic recording pH-stat.
- Record variation in pH or EMF as a function of titrant added.
- Titrate to any preset end point.
- Record first and second derivative titration curve.
- Automatic titration in aqueous or non-aqueous media:
 - Acid-base reactions —
 - Oxidation-reduction reactions —
 - Precipitation reactions —
 - Complex-ion reactions —
- Kinetic analysis with permanent record of reaction rate.
- Automated quality control of laboratory, pilot plant or industrial processes.

FEATURES

- Built-in simulated signal to check titrator's response.
- Proportional titrant addition as end-point is approached.
- Titrant delivery rate and chart speed are both variable.
- Automatic cutoff permits unattended operation.
- Interchangeable burets for micro and macro titrations.
- Provision for a Polarad plug-in differentiator. Shows pH (on the meter) as recorder plots first or second derivative.
- Continuously variable recorder span — maximum sensitivity full span 2 pH units.
- Accuracy ± 0.02 pH units or ± 1.2 millivolts.

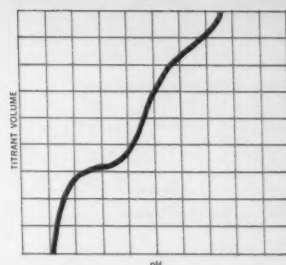
Now, tedious potentiometric titrations that required time-consuming point-by-point analysis can be done automatically. The new Model AT-2A Automatic Recording Titrator makes variable and constant pH titrations automatically, simultaneously providing a permanent record. This new instrument will free chemists for more productive analyses as it speeds routine but difficult measurements.

SCIENTIFIC INSTRUMENTS

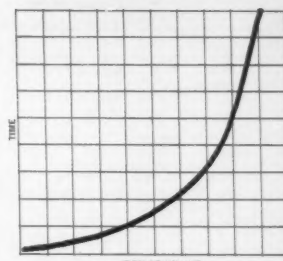
A DIVISION OF POLARAD ELECTRONICS CORPORATION

43-20 34th Street • Long Island City I. N. Y.

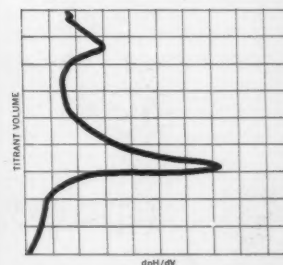
©P.E.C.



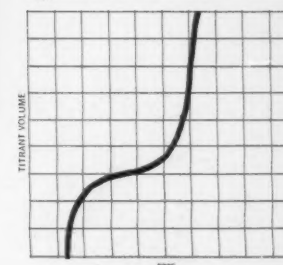
Typical Variable pH Titration



Typical Constant pH Titration



Typical First Derivative Titration



Typical Precipitation Titration

SCIENTIFIC INSTRUMENTS

Please send me information and specifications on:

- ☐ Model AT-2A Automatic Recording Titrator
- ☐ Model RV-2 Rotating Cylinder Viscometer (see reverse side of page)



My application is _____

Name _____

Title _____ Dept. _____

Company _____

Address _____

City _____ Zone _____ State _____

ROTATING CYLINDER VISCOMETER

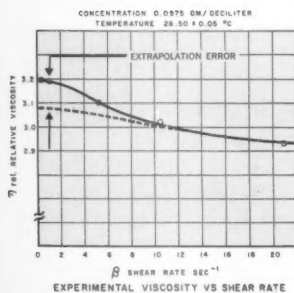
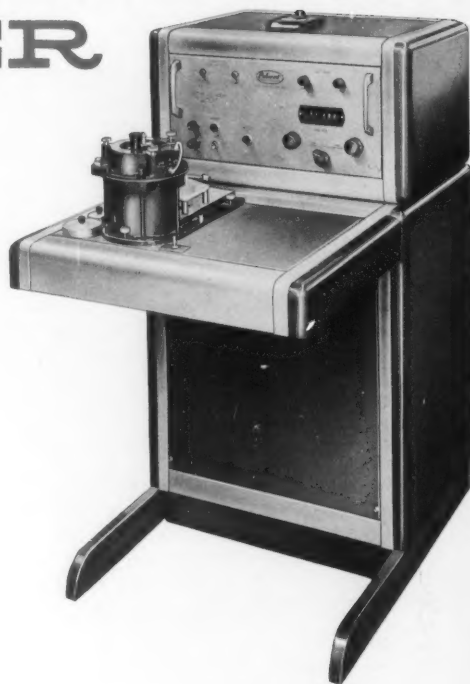
MODEL RV-2

**True intrinsic viscosity determination
at extremely low shear rates**

- Molecular weight characterization by intrinsic viscosity
- Kinetic analysis of enzyme systems
- Analysis of polymerization rates

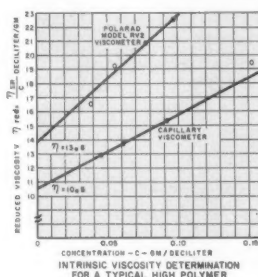
FEATURES

- Extremely low shear rate (0.2 sec^{-1}) virtually eliminates extrapolation to zero.
- Coaxial cylinders combine uniform distribution of shear rate with convenient sample changing.
- Rapid, simple selection of shear rates.
- Electrostatic restoring torque eliminates torsion wire problems.
- Temperature of sample maintained to within $\pm 0.05^\circ\text{C}$.
- Cylinder and float constructed from non-corrosive and non-contaminating material.
- The density of the liquid has no effect on the viscosity measurement.



Viscosity vs. Shear Rate

Analysis of Viscosity vs. Shear Rate for a water soluble high polymer demonstrates the effectiveness of this viscometer in measurement of true zero shear gradient viscosity. It can be seen that there was no necessity to extrapolate to zero shear rate because the instrument is capable of viscosity measurement on the plateau approaching this value.



Intrinsic Viscosity Determination for a Typical High Polymer

Here reduced viscosity $\frac{\eta_{sp}}{C}$ is extrapolated to zero concentration to obtain intrinsic viscosity $[\eta] \text{ } \beta=0$.
 $C=0$.

Values of reduced viscosity were obtained directly without extrapolation to zero shear gradient. The lower curve is typical of the error to be expected when apparent viscosity is obtained at the high and nonuniform shear rate implicit in the capillary method.

Postage
Will be Paid
by
Addressee

No
Postage Stamp
Necessary
If Mailed in the
United States

BUSINESS REPLY CARD

First Class Permit No. 18, Long Island City 1, N. Y.

SCIENTIFIC
INSTRUMENTS

POLARAD ELECTRONICS CORP

43-20 34th St., Long Island City 1, N. Y.



Specifications:

Shear Stress Range: 0.002 dyne/cm^2
to 1.6 dyne/cm^2 .

Shear Rate Range: 0.2 sec^{-1} to 50 sec^{-1}
in 26 steps.

Viscosity Range: Up to 800 centipoise
at 0.2 sec^{-1} .

Accuracy: $\pm 0.5\%$ of sample viscosity.

Cylinder Temperature: Constant to within
 0.05°C of desired temperature when located
in a temperature-controlled ($\pm 2^\circ\text{C}$) room.

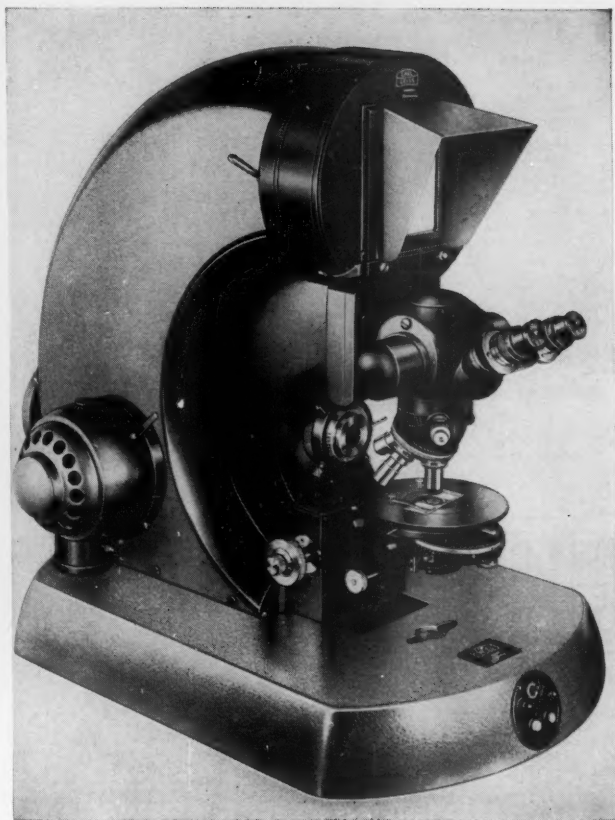
SCIENTIFIC
INSTRUMENTS

A DIVISION OF POLARAD ELECTRONICS CORPORATION

43-20 34th Street • Long Island City 1, N. Y.

© P.E.C.

NEW CAMERA MICROSCOPE



ULTRAPHOT II

MADE BY



WEST GERMANY

The revolutionary design
of the **ULTRAPHOT II** is years ahead
of existing equipment!

Microscope, camera and exposure meter combined in one instrument. Completely automatic shutter is activated by a photo-electric cell computing exact exposure times and insuring correctly exposed photomicrographs under even the most adverse conditions.

Three different light sources, including an electrically-controlled arc lamp, are available for instant use. By utilizing the Koehler principle, specimens can be observed and photographed in bright field, dark field and phase contrast, as well as with incident light.

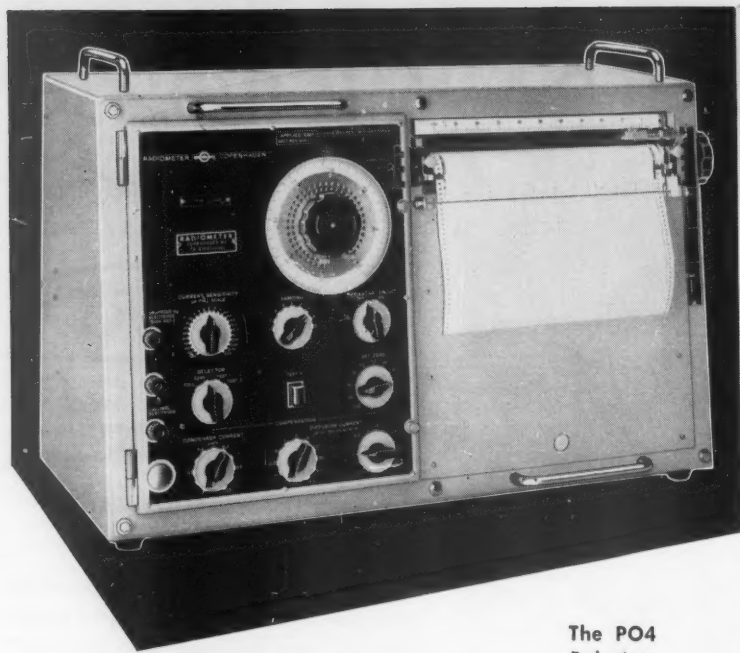
A built-in movable mirror system simulates bellows extension up to 12 inches and permits gradual magnification from 6.5x to 1700x. A 4 x 5-inch back also allows the use of available smaller sheet film adapters.

Write for free detailed literature

CARL ZEISS, INC.

485 FIFTH AVENUE, NEW YORK 17, N. Y.

COMPLETE
SERVICE FACILITIES



The PO4
Polariter

a new
research
and control
technique
with vast
potential

POLAROGRAPHY

is a comparatively new technique offering vast possibilities in the field of chemical analysis, inorganic and organic. The measurement of diffusion current in a well defined electrolytic process makes it possible to determine the unknown component in concentrations down to 10^{-4} mol per liter or less. The method can be applied to any chemical system having a well defined reduction potential, and can result in determinations to a fraction of a microgram per gram of solution.

The Radiometer PO4 Polariter is a mains operated unit, presenting polarographic traces of high sensitivity and resolving power on built-in direct pen recorder. Provision for derivative and peak polarograms, damping, condenser current compensation, and maximum sensitivity of .00008 microamperes per mm. on a 250 mm. recording width, makes the PO4 a complete and versatile instrument, ideal for series determinations utilizing unskilled laboratory help. Let us know and we will be happy to send you complete catalogue and literature. Radiometer PO3, more modestly priced for less stringent applications, is also available.

If you wish to receive the Radiometer quarterly journal POLAROGRAPHICS, containing literature reviews and current polarographic abstracts, please advise us.

SOLD AND SERVICED IN U.S.A. BY
WELWYN INTERNATIONAL INC.
3355 Edgecliff Terrace CLEVELAND 11, OHIO



RADIOMETER
72 Endrupvej COPENHAGEN, DENMARK

In Canada: Contact any Branch of Canadian Laboratory Supplies Limited

GET READY FOR THE SPACE and SCIENCE ERA! SEE SATELLITES, MOON ROCKETS



AMAZING OPTICAL BUYS

and OTHER SCIENTIFIC BARGAINS

FREE! FREE!
SEND FOR GIANT
128 PAGE CAT. "W"
See Below

American Made — Terrific Buy! Over 50% Saving STEREO MICROSCOPE



Years in development. Equals \$300 to \$400 instrument. Precision American made. Used for checking, inspecting, small assembly work. Up to 3" working distance. Clear, sharp, erect image. Wide, 3 dimensional field. 2 sets of objectives on rotating turret. 23X and 40X. 10 Days Free Trial.

Stock No. 85,056-W\$99.50
f.o.b. Barrington, N.J.

Low Power Supplementary Lens Attachment for above Stereo—provides 15X down to 6X with clear, extra large 1 1/2" field at 6X.
Stock No. 30,276-W\$7.50

NEW, LOW-COST LAB PROJECTOR SHOWS EXPERIMENTS ON SCREEN!



New way to teach chemistry, biology. Project on-the-spot experiments, on screen or wall, with magnification, actually as they progress. Important phases, reactions may be observed by student group in revealing size—perfect vehicle for clear-cut instruction. Projector comes with a 3-element, 80mm focal length f.8.5 anastigmat lens and a fast 38mm focal length, 4-element f.1.2 lens for microslide projection use. Also you get prism erecting system; special elevated slide and specimen projection stage; standard 35mm, 2" x 2" slide carrier; 35mm strip film holder. Additional accessories available—water cooled stage; polarizing filters; petri dishes; miniature test tubes and holders; gas absorption apparatus; electrolytic cells and many others.

Stock No. 70,230-W\$45.00 Postpaid

OFFSPRING OF SCIENCE . . . REALLY BEAUTIFUL CIRCULAR DIFFRACTION GRATINGS CUFF LINKS and EARRINGS

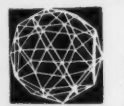


A Dazzling Rainbow of Color!

As a scientific phenomenon, this new kind of jewelry is capturing attention everywhere. Shimmering rainbows of gem-like color in earrings and cuff links of exquisite beauty—made with CIRCULAR DIFFRACTION GRATING REPLICA. Just as a prism breaks up light into its full range of individual colors, so does the Diffraction Grating.

Stock No. 30,349-W—Earrings (clip style)Tax Incl. \$2.75 Postpd.
Stock No. 30,350-W—Cuff LinksTax Incl. \$2.75 Postpd.

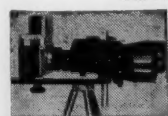
D-STIX CONSTRUCTION KITS For Scientists, Teachers



Scientists, teachers, planners—let D-STIX help you visualize and crystallize complex ideas. Colored wood sticks 3/8" thick and "easy-on" rubber joints approx. 3/16" diam. fit together fast—help you work out molecular structures, geometric figures, structural members, shapes, models of scientific apparatus. Ideal for "3-dimensional thinking," instruction, demonstration. Durable kits. Money-back guarantee.

Stock No. 70,210-W (370 pcs)\$5.00
Stock No. 70,211-W (452 pcs)\$7.00

NEW BINOCULAR-TO-CAMERA HOLDER Will Fit Any Camera



For Exciting Telephoto Pictures. Bring distant objects 7 times nearer with a 35mm camera. 7x30 binocular and our NEW BINOCULAR-TO-CAMERA HOLDER. Ideal for long-range shots of wild life, ships, people, vistas. Camera and binoculars attach easily. Use any binocular or monocular—any camera, still or movie. Take color or black and white. Attractive gray crinkle and bright chrome finish, 10" long. Full directions for taking telephotos included.

Stock No. 70,223-W\$11.50 Postpaid

ASSEMBLED AND READY TO USE!



Photographers! This is an actual photograph of the moon taken through our Astronomical Telescope by a 17-year student.

See the Stars, Moon, Planets Close Up! 3" ASTRONOMICAL REFLECTING TELESCOPE 60 to 180 Power. An unusual Buy! Famous Mt. Palomar Type

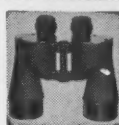
You'll see the Rings of Saturn, the fascinating planet Mars, huge craters on the Moon, Star Clusters, Moons of Jupiter in detail. Galaxies! Equatorial mount with lock on both axes. Aluminized and over-coated 3" diameter high-speed f/10 mirror. Telescope comes equipped with a 60X eyepiece and a mounted Barlow Lens, giving you 60 to 180 power. An Optical Finder Telescope, always so essential, is also included. Sturdy, hardwood, portable tripod—FREE with Scope—Valuable STAR CHART, plus 272 page "HANDBOOK OF HEAVENS" plus "HOW TO USE YOUR TELESCOPE" BOOK.

Stock No. 85,050-W\$29.95 Postpaid

4 1/2" Reflecting Telescope—up to 255 Power
Stock No. 85,006-W\$74.50 F.O.B. Barrington, N.J.

War Surplus American-Made 7x50 Binoculars

Big savings! Brand new! Crystal clear viewing—7 power. Every optical element is coated. An excellent night glass—the size recommended for satellite viewing. Individual eye focus. Exit pupil 7mm. Approx. field at 1,000 yds. is 376 ft. Carrying case included. American 7 x 50's normally cost \$195. Our war surplus price saves you real money.



Stock No. 1533-WOnly \$55.00 postpd.
(Tax included)

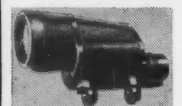
Terrific Buy! American Model OPAQUE PROJECTOR

Projects illustrations up to 3" x 3 1/2" and enlarges them. No film or negatives needed. Projects charts, diagrams, pictures, photos, lettering in full color or black-and-white. Operates on 115 volt, A.C. current. 6-ft. extension cord and plug included. Operates on 60 watt bulb, not included. Size 12" x 8" x 4 1/2" wide. Weight 1 lb., 2 oz. Plastic case with built-in handle.



Stock No. 70,199-W\$7.95 Postpaid

Take Telephoto Shots Thru 7 x 50 MONOCULAR



This is fine quality. American made instrument—war surplus! Actually 1/2 of U.S. Govt. 7 x 50 Binocular. Used for general observation both day and night and to take fascinating telephoto shots with your camera. Brand new. \$95 value. Due to Japanese competition we close these out at a bargain price. Directions and mounting hints included.

Stock No. 50,003-W\$15.00 Postpaid

Beginner's Lens Kits! Fun for adults! Fun for children! Kits include plainly written, illustrated booklet showing how you can build lots of optical items.

Stock No. 2-W—10 Lenses\$1.00 Postpaid

ASTRO-COMPASS AND TRANSIT



War surplus! Astro Compass alone cost Govt. \$75. We have added a Sighting Level to improve versatility. Hundreds of uses in carpentry, brick laying, foundation work, grading, irrigation or drainage. Much below cost of ordinary surveying instruments. Ideal for do-it-yourselfers. 10 1/2" high, 8" long, 4" wide. Adjustable leveling platform—2 spirit levels for aligning—also spirit level in sighting attachment. A tremendous bargain.

Stock No. 70,267-W\$19.95 postpaid

WAR SURPLUS!—INFRARED SNOOPERSCOPE Govt. Cost \$900—Bargain at \$39.50



Converts infrared to visible light. See in total darkness without being seen. Use in lab, factory, classroom, etc. Completely portable. Operates on two flashlight batteries (not included). Image is quite good, may be made even better by careful focusing. Size 11 1/2" x 8". Weight, with carrying case 12 lbs. No infrared light source is furnished. (See below).

Stock No. 85,098-W\$39.50 f.o.b. Barrington, N.J.

You will need a 6-volt transformer or 6 V auto battery to operate.

Stock No. 80,035-W\$10.00 Postpaid

LOW-COST VERSATILE SPECTROSCOPE



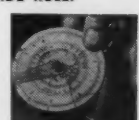
Ideal for school use. Can be used with transmission diffraction grating replica (a piece is supplied) or with prism. It has a rotating prism table with scale. The telescope arm extends through 120°. 10X eyepiece is standard microscope size with reticle. Slight is adjustable. Optical system includes two achromatic 25mm diam., 122mm f.l. lenses. Arms extend from 5" to 8" for focusing. Diameter of base is 6". Overall height and overall width approx. 14". Instructions included.

Stock No. 70,229-W\$39.50 Postpaid

NOTICE: EDMUND IS NOW HEADQUARTERS FOR MATHEMATICS AND TEACHING AIDS! SEE DOZENS OF OFFERINGS IN OUR FREE CATALOG—"W"

NEW! CIRCULAR SLIDE RULE!

Pocket Size—
Fast—Easy to Use!



Be a Math Wiz! New Circular Slide Rule multiplies, divides, figures fractions, percentages, squares, cubes, roots, proportions, circumferences, areas, retail price, fuel consumption. Eliminates the confusions of ordinary slide-rules. Directions included.

Stock No. 30,336-W\$4.95 postpaid

FREE CATALOG!

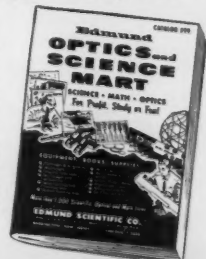
Optics for the Science Class!
Optics for the Space Era!

128 PAGES! OVER
1000 OPTICAL BUYS!

Huge selection of lenses, prisms, war surplus optical instruments, parts and accessories. Telescopes, microscopes, binoculars, infrared sniperscopes, etc. Low-cost Science and Math Learning and Teaching aids.

Request Catalog W.

Easy Payment Plan Available! Details with Catalog!



ORDER BY STOCK NUMBER . . . SEND CHECK OR MONEY ORDER . . . SATISFACTION GUARANTEED!

EDMUND SCIENTIFIC CO. BARRINGTON, NEW JERSEY

BAIRD-ATOMIC INC.
of
CAMBRIDGE, MASS.

is proud to announce the acquisition of

AXLER ASSOCIATES
of Corona, New York,

MANUFACTURER OF

**Ultraviolet Interference Filters and
Instruments for Chemical analysis**

Baird-Atomic now offers a complete line of superior
quality visible and ultraviolet interference filters
covering the range from 210-1,000 millimicrons

For detailed price, delivery and technical information,
send your specific requirements to:

Filter Department



33 UNIVERSITY RD.,
CAMBRIDGE 38, MASS.

OFFICES IN

Boston • New York • Philadelphia
Pittsburgh • Washington • Cleveland
Detroit • Chicago • Atlanta • Dallas
Los Angeles • San Francisco • Montreal
Principal Cities Abroad

Research Model ECBi



Elgeet

of Rochester

is *FIRST* to bring you

PROFESSIONAL PERFORMANCE

in a *Student-Teaching Microscope*

for only \$110.50

\$99.45 in lots of five or more

Elgeet-OLYMPUS

Student-Teaching Model S-2

Now, many of the advanced features of famous Elgeet-Olympus Research Microscopes have been incorporated in the new Elgeet-Olympus line of Student-Teaching Microscopes, extending to educators for the first time a number of important instructional advantages.

In addition to its optical and mechanical superiority, you will note the exceptionally solid "heft" of your Elgeet-Olympus Student-Teaching Microscope . . . ruggedly

engineered of "classroom-proof" materials to withstand daily use by untrained hands. Minimum maintenance is further assured by such refinements as completely enclosed rack-and-pinion movements, and a dust-proof, self-centering revolving nosepiece.

Prove to yourself with a 10-day Free Trial that Elgeet-Olympus Student-Teaching Microscopes provide the logical answer to educators who seek the best . . . on a budget.

IMMEDIATE DELIVERY • WRITE Dept. SM-11

Elgeet OPTICAL CO., INC. . . . SCIENTIFIC INSTRUMENT AND APPARATUS DIVISION
838 SMITH STREET • ROCHESTER 6, NEW YORK
"Quality is our watchword . . . Precision Engineering our constant goal"

SARGENT

CONSTANT RATE BURETTE

for Titration with Laboratory Recorders

BURETTES—Motor Driven, Constant Rate, Precision Grade, 10 or 50 ml, Sargent.

A precise constant delivery device primarily intended for titration with recorders and comprising precision ground Pyrex Brand Glass solution barrels and plungers, operating on a simple displacement principle with the plunger driven at a constant rate by a synchronous motor. Sealing is effected by replaceable Neoprene "O" rings and Quad rings held in special stainless steel collars with spring loading. Motor drive is transmitted to the plunger by a precision ground stainless steel lead screw running in a Nylon following member. Drive is self-limiting at both ends of the lead screw and automatically resumes on reversal.

A separate motor provides rapid motion of the plunger in both directions for refilling from a directly connected reservoir and for discharging excess titrant and flushing.

Calibration of delivered volumes is determined solely by dimensions and rate of travel of the plunger, registration of the resultant delivery volumes being shown on a four digit counter synchronously driven.

Barrel and plunger assemblies are completely interchangeable permitting accommodation of a total volume of either 10 ml or 50 ml. The rate of drive delivers either volume in 10 minutes. Drive and control components are mounted in a cabinet with a protecting stainless steel cover on which the burette assembly is supported. The panel of this case provides pilot light, fuse, rapid drive reversing switch, and starting button which may be locked in for continuous delivery and for automatic applications. The rear panel provides connecting facilities for using the burette with second derivative automatic titrators with automatic shut-off at the end point and for remote operation by direct connection to Sargent recorders S-72150 and S-72151 for fully recorded titrations.

The three-way glass header connects to the burette barrels by a 10/30 F ground joint. The delivery tip is similarly connected to the header by a 10/30 F ground joint.

Accuracy, 0.1% of burette capacity; readability and reproducibility, 0.01 ml with 50 ml capacity, 0.002 ml with 10 ml capacity. Height of base, 5 inches; depth of base, 8 $\frac{3}{4}$ inches; width of base, 10 inches; height over header, 23 inches.

For more information write for Bulletin CR

S-11120-1 BURETTE—Motor Driven, Constant Rate, Precision Grade, 10 ml, Sargent. With S-11121-1 burette equipment for 10 ml capacity only..... **\$280.00**

S-11120-5 BURETTE—Motor Driven, Constant Rate, Precision Grade, 50 ml, Sargent. With S-11121-5 burette equipment for 50 ml capacity only..... **\$290.00**

S-11121-1 Burette Equipment Unit, Only, 10 ml. For converting S-11120-5 to 10 ml volume **\$27.00**

S-11121-5 Burette Equipment Unit, Only, 50 ml. For converting S-11120-1 to 50 ml volume **\$37.00**



Designed and Manufactured by E. H. Sargent & Co.



SARGENT

SCIENTIFIC LABORATORY INSTRUMENTS • APPARATUS • SUPPLIES • CHEMICALS

E. H. SARGENT & CO., 4647 W. FOSTER, CHICAGO 30, ILLINOIS
DETROIT 4, MICH. • DALLAS 35, TEXAS • BIRMINGHAM 4, ALA. • SPRINGFIELD, N.J.

ACETATES

WHAT'S IN MALLINCKRODT AMMONIUM ACETATE AR...

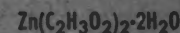
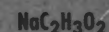
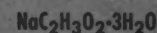
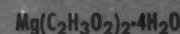
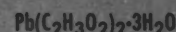
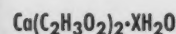
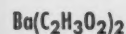
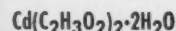
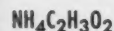
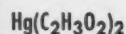
BESIDES $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$?

An extra factor of *dependability*—just as in all Mallinckrodt AR's! An unusually large group of quality control specialists carefully check each lot ... to make sure label specifications are met or bettered before giving the "OK" for shipment.

You can be confident that Ammonium Acetate AR and every Mallinckrodt AR[®] measures up to the highest standards of uniformity and purity. That's one reason more chemists specify Mallinckrodt AR's than any other reagent.

Mallinckrodt distributors are ready to give you fast delivery on AR's and other laboratory needs.

OTHER MALLINCKRODT AR ACETATES



USE AR's AS
PROCESS
CHEMICALS,
TOO... AVOID
PRODUCTION
AND QUALITY
PROBLEMS



Linking Chemistry to Industry

St. Louis
New York



WHAT KIND
OF
CAN I
EXPECT ON
OUR

service micro- scope?

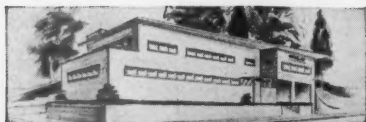
This is a common question asked by new and prospective owners of any microscope.

Owners, present and prospective, of any WILD Microscope, are assured of fast service and fast return of the instrument . . . often overnight.

Most important: Only WILD trained selected technicians, with many years' experience in WILD Microscope construction and assembly, are permitted to service your instrument.

FULL FACTORY SERVICES

*The FIRST name in Surveying Instruments, Photogrammetric Equipment and Microscopes



INSTRUMENTS, INC.

Main at Covert Street • Port Washington, New York
Port Washington 7-4843
In Canada

Wild of Canada Ltd., 157 MacLaren St., Ottawa, Ontario

Letters

Radiation Carcinogenesis

A number of difficulties lie in the way of accepting Blum's thesis [*Science* **130**, 1545 (1959)] that his data on ultraviolet carcinogenesis in mice and his mathematical deductions therefrom are evidence for the concept that there is no threshold dose for radiation carcinogenesis. It is not simply that he is arguing not from data but from projections of that data into unstudied areas, or that this was done even though direct observation was possible. There is also the fact that other data from his series of studies point rather directly to the opposite conclusion. They not only describe a threshold phenomenon but offer some clues as to quantitation.

As to the first objection, Blum in his Fig. 1 presents the incidence data for varying doses of radiation. According to his figure, halving the radiation dose means that 0.15 is added on to the log of the time necessary for tumor development. According to the chart this relation holds for each halving of dose down to 1/32 of the dose required for most rapid carcinogenesis. The chart is described as being based on experiments described in his recent monograph (1). Unfortunately, neither the monograph or the original papers I could find deal with doses corresponding to his two lowest curves, and the third dose level is described as treated partly by extrapolation (2). Hence it would appear that the dose ranges on which the question of threshold is based are quite narrow, more so than the diagrams would suggest.

If such information were all that were available to us, there would be some justification for making projections therefrom, even though the tentative nature of the projections would have to be emphasized. Actually this is not the case. Blum makes the point that there is a practical limit on the doses of carcinogenic radiation that can be tested because, with low doses, the time for cancer development will be longer than the life span of the animal. Of course, if the first cancers are not to appear until after all animals are dead, we have a practical threshold if not a biologic one. But further than this, our information need not be as limited as Blum claims. He does not spell it out in his article, but all his figures on dose-time relations are concerned with the time within which cancers appear visible to the unaided eye. Nowhere in his work could I find reference to the power of the microscope to detect cancers much earlier in their course. Given his figures for cell size and rate of growth, a cancer should have a cross section of 100

cells visible under the microscope after an interval one-third that necessary for a gross lesion to develop. This means that doses of irradiation supposedly leading to far more slowly growing tumors than have presently been studied are quite accessible to experimental investigation, so that abstract speculation is neither needed nor appropriate.

But beyond these caveats, there is evidence on threshold existence in other work of Blum himself: his studies on the effect of interruption of irradiation and its resumption after a 30-day rest period (3). (The figures for 30-percent tumor incidence are the most convenient to analyze because there was a second interruption of radiation in some series before the 50-percent incidence time was reached.) According to these figures, with uninterrupted radiation it took 95 doses of 2×10^7 ergs/cm² to produce visible cancer in 30 percent of the animals. Interruption late in the course of treatment, after 53 doses, meant that only 85 doses were needed for tumor production; the tumors apparently grew during the rest period. This, however, was not the case when the interruption occurred earlier in the course of treatment. When the rest period was given after 33 treatments, there was no progression, and the same total of 95 treatments was needed for cancer production as had been true for the controls. By contrast, when the rest period was introduced still earlier, there was recovery from the first course and more radiation was needed than if there had been no interruption. With the break after 23 treatments, an additional 81 treatments for a total of 104 were needed. And if only three or four treatments were given (the actual number is not clear), more radiation (100 doses) was needed after the rest period than if both the rest period and the first doses of radiation had been omitted.

It seems to me that this evidence for reversibility of the effects of small amounts of radiation bears directly on the question of a threshold. For if there is a dose of radiation low enough so that the exposed tissues recover or become even less than normally sensitive to subsequent radiation, this must be a subthreshold dose by definition. It appears that only above a certain dose level are the effects of radiation irreversible and hence inexorably carcinogenic. Hence, from both negative and positive aspects I find myself unable to accept Blum's thesis that no radiation threshold exists for carcinogenesis.

Extrapolation of this work to carcinogenesis by ionizing radiation presents other problems. It is reasonable to think that there might be parallel quantitative patterns. At least it is hard to imagine that there is no correlation between

(Continued on page 866)

Modern . . . Versatile . . .
. . . Economical!

INTERNATIONAL'S ALL-NEW MODEL UV UNIVERSAL CENTRIFUGE

This latest contribution to centrifuging progress combines in one moderately priced unit all the features most wanted by medical and industrial laboratories.

STREAMLINED DESIGN! Cabinetized construction adds new eye appeal to traditional International "work horse" ruggedness. Unitized control panel simplifies operation. Convenient storage space keeps accessories handy.

WIDE-RANGE VERSATILITY! Swings more than 80 different accessory combinations . . . at speeds up to 5400 RPM. For example: 4 one-liter bottles, 150 serum tubes, 6-250 ml bottles, 16-50 ml tubes.

MOST-WANTED FEATURES! Stainless steel guard bowl makes cleaning easy. Electric tachometer, timer and brake assure accuracy . . . improve performance. Powerful series-wound motor is International-made for extra reliability.

GET ALL THE FACTS about this modern, versatile, economical centrifuge . . . the one model you can standardize on for general-purpose laboratory work.



INTERNATIONAL EQUIPMENT CO.

1219 SOLDIERS FIELD ROAD • BOSTON 35, MASSACHUSETTS

Please rush complete data on International's all-new MODEL UV Universal Centrifuge and accessories. Sold and serviced the world over by authorized International dealers.

Name..... Title.....

Institution.....

Street & No.....

City..... Zone..... State.....

after
y for
means
posedly
owing
studied
al in-
lation
.
ere is
other
es on
iation
y rest
percent
nven-
a sec-
some
vidence
these
ion it
m² to
ent of
n the
doses,
eeded
s ap-
period.
when
in the
e rest
ments,
same
ed for
ue for
e rest
there
e and
there
h the
ditional
were
treat-
umber
(100
period
ne first
ted.
ce for
small
tly on
f there
ugh so
or be-
nsitive
ust be
on. It
n dose
n irre-
arcino-
re and
able to
diation
s.
arcino-
resents
think
antita-
imag-
etween

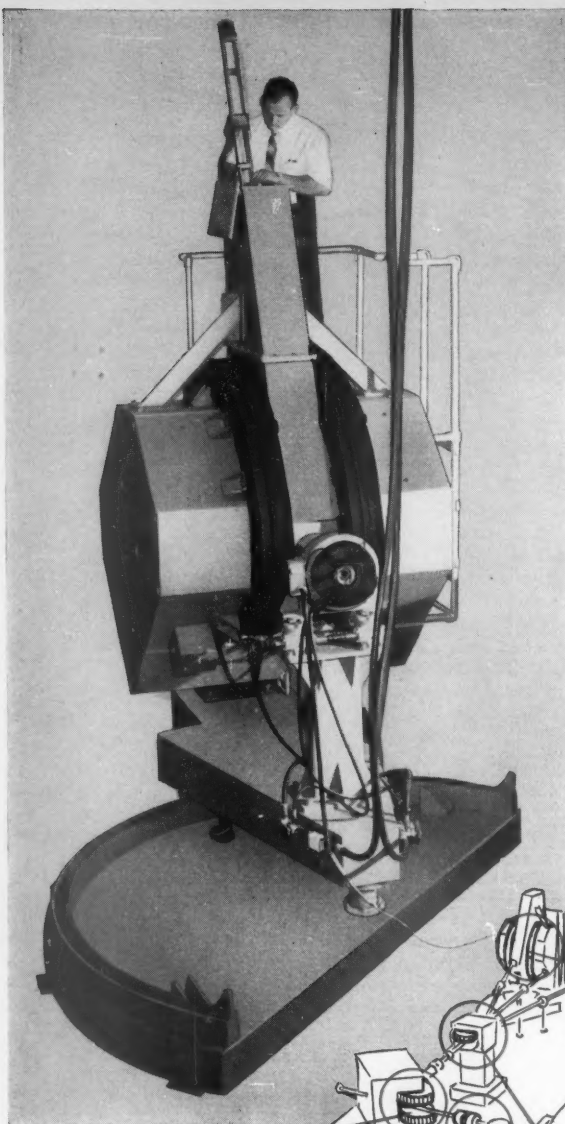
NUCLEAR PARTICLE ANALYZING MAGNETS

Combined Magnetic Spectrograph and Spectrometer* designed and built for Chalk River Laboratories, Atomic Energy of Canada, Ltd., for energy analysis of protons, deuterons, and alpha particles.

- Magnetic rigidity —
Up to $B\rho = 865$ kilogauss-cm (12-Mev tritons)
- Resolving power (spectrograph) —
 $E/\Delta E = 10^3$ or better
- Solid angle (spectrograph) —
 $\Omega = 1.4 \times 10^{-3}$ steradians (max)
- Solid angle (spectrometer) —
 $\Omega = 0.9 \times 10^{-2}$ steradians (max)
- Reaction angle —
 $\theta = 0$ to 135 degrees
- Detector —
Nuclear track plate and scintillation counter

*For further technical reference, see H.A. Enge, RSI 29, 885 (1958)

TYPICAL MAGNET SYSTEM FOR 12-MEV TANDEM *Van de Graaff*[®] ACCELERATOR



90° beam analyzing and stabilizing magnet for $B\rho = 865$ kilogauss-cm (12-Mev tritons)

Quadruple lens pair—2" aperture for post-acceleration beam focusing

Multi-port switching magnet

Combined magnetic spectrograph and spectrometer

Pre-acceleration negative ion analyzing magnet



For detailed information on magnets and accelerators, write to Technical Sales:

HIGH VOLTAGE ENGINEERING CORPORATION
BURLINGTON, MASSACHUSETTS - U. S. A.

AMERICAN ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE

Board of Directors

CHAUNCEY D. LEAKE, *President*
THOMAS PARK, *President Elect*
PAUL F. KLOPSTEG, *Retiring President*
HARRISON BROWN
H. BENTLEY GLASS
MARGARET MEAD
DON K. PRICE
MINA REES
ALFRED S. ROMER
WILLIAM W. RUBEY
ALAN T. WATERMAN
PAUL A. SCHERER, *Treasurer*
DAEL WOLFLE, *Executive Officer*

Editorial Board

DONALD J. HUGHES H. BURR STEINBACH
KONRAD B. KRAUSKOPF WILLIAM L. STRAUS, JR.
EDWIN M. LERNER EDWARD L. TATUM

Editorial Staff

DAEL WOLFLE, *Executive Officer*
GRAHAM DUSHANE, *Editor*
JOSEPH TURNER, *Assistant Editor*
ROBERT V. ORMES, *Assistant Editor*

CHARLOTTE F. CHAMBERS, SARAH S. DEES, NANCY
S. HAMILTON, OLIVER W. HEATWOLE, YUKIE
KOZAI, ELLEN E. MURPHY, ELEANOR D. O'HARA,
BETHSABE PEDERSEN, NANCY L. TEIMOURIAN, LOIS
W. WOODWORTH

EARL J. SCHERAGO, *Advertising Representative*



SCIENCE, which is now combined with THE SCIENTIFIC MONTHLY, is published each Friday by the American Association for the Advancement of Science at National Publishing Company, Washington, D.C. The joint journal is published in the SCIENCE format. SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

Editorial and personnel-placement correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. For detailed suggestions on the preparation of manuscripts and illustrations, see *Science* 125, 16 (4 Jan. 1957).

Display-advertising correspondence should be addressed to SCIENCE, Room 740, 11 West 42 St., New York 36, N.Y.

Change of address notification should be sent to 1515 Massachusetts Ave., NW, Washington 5, D.C., 4 weeks in advance. If possible, furnish an address label from a recent issue. Give both old and new addresses, including zone numbers, if any.

Annual subscriptions: \$8.50; foreign postage, \$1.50; Canadian postage, 75¢. Single copies, 35¢. Cable address: Advancesci, Washington.

Copyright 1960 by the American Association for the Advancement of Science.

Space Exploration as Propaganda

Since Veblen introduced the idea of conspicuous consumption, we have recognized that many expenditures are made neither for comfort nor for use, but to maintain one's position in the community. Scientists and public officials in Washington are now wondering to what extent an analogous principle applies to a country seeking to maintain its position in the community of nations. Much of the debate over the adequacy of our space program concerns the question whether comparison of Soviet and American achievements in placing very large payloads in orbit is adversely affecting our prestige abroad.

Among those who see the influence of the United States suffering because of our showing in space is George V. Allen, director of the United States Information Agency. In testimony this year before the House Science and Astronautics Committee, Allen said that many people throughout the world do judge a nation's science and technology in terms of what they can understand of its space efforts. As things have turned out, the testimony continues, Soviet achievements have greatly exceeded world expectations, while our efforts have fallen short. One immediate result of Soviet success, according to Allen, is the better reception now accorded Soviet technological and cultural exports.

A key spokesman for the view that our present rate of achievement in space is adequate is also a key figure—or, rather, the key figure—in the administration. At a news conference, President Eisenhower said that he found no reason for us "to bow our heads in shame." If Soviet efforts have had a greater appeal to the imagination of the public, he continued, actual examination of the record will show that we have done good, hard work.

To consider space exploration in terms of conspicuous consumption is not meant to imply that such exploration is not of genuine scientific import. A Cadillac will get you there and back. Nor is such consideration meant to imply that space exploration is the best indicator that economists can devise to measure a nation's scientific and technological prowess. The question at issue is simply whether space exploration is a measure of power accepted by the people of countries that we want to influence. We may not feel inferior, we may not be inferior, but the question is what does the rest of the world think of us.

To estimate what the rest of the world does make of us, a certain amount of data can be gathered, and a certain range of arguments can be based on that data. If outer space is a subject for research, so is its effect on the opinions and behavior of people. And here we are struck by one aspect of Allen's testimony. He cites in support of his views the results of public opinion polls conducted overseas and also the reports of our government offices overseas.

The information that we now possess, of course, may be too meager to have much influence on our policies, but if such is the case, it is simply an argument that we do something about getting better information. How important space exploration is as propaganda is a question over which sincere men can disagree, but the answer is not simply a matter of intuition.—J.T.

Here Is A Complete Gamma Spectrometer



This transistorized spectrometer is by far the smallest and most compact available—yet it has more important and unique features than any other on the market today. Furthermore, it can be used directly with the Packard Auto-Gamma Sample Changer for completely automatic counting of test tube samples.

Write for Complete Information. Request Bulletin 400.

Packard Instrument Company, Inc.
P. O. BOX 428-A • LA GRANGE, ILLINOIS

CURRENT PROBLEMS IN RESEARCH

Some Prehistoric Connections between Siberia and America

The intercontinental cultural resemblances can now
be studied in terms of more accurate chronology.

James B. Griffin

When western Europeans discovered the Americas they not only took on the task of exploring and colonizing the Western Hemisphere, but they also faced the question of the origin of the peoples who inhabited the New World. The name "Indians" was first applied under the misapprehension that the discovery had been made of the outer regions of India. Among the explanations for the peopling of the New World, one of the most common was a connection to the Lost Tribes of Israel.

One of the major difficulties in obtaining a satisfactory answer to the question of the New World population was the limitation of knowledge available during the 16th and 17th centuries about the age of the earth and about the age of human beings on the earth. With the exploration of the north Pacific area and the discovery of Bering Strait, a great many people concerned with the question of the origin of the Indians, recognizing the resemblance of the American Indian to the Mongoloid people, suggested that Bering Strait was the nearest or the easiest way by which people could have passed from Asia into North America. During the 18th and the early part of the 19th centuries, not only the Bering Strait crossing was suggested as a means

by which America was peopled after 2000 B.C., but there were also theories of movements across the Atlantic from the Mediterranean area and of movements of people across the Pacific to populate the southern parts of the New World. Some of these quaint ideas still persist.

During the past 100 years, with the extraordinary growth of knowledge in various scientific fields, it has been possible to provide much more satisfactory explanations of Indian origins. The study of the geological features of the earth, particularly in Europe during the early 1800's proved the great antiquity of the earth. The development of Pleistocene or Ice Age studies in Europe and America indicated very clearly that implements of human manufacture were associated with this last major stage in the shaping of the earth's surface features. The discoveries and study of fossil men in the Old World from *Pithecanthropus* in Java to Neanderthal in Europe, and the recognition of Cro-Magnon in Europe associated with the late phase of the Old World stone industries gave man an antiquity in Eurasia which was not dreamed of in the centuries preceding. The studies of European prehistory certified the existence of a long period of development of human culture and that by the time of the late Pleistocene in Europe man had reached a fairly advanced stage of hunting and gather-

ing economy with a distinctive and spectacular art style. Mural painting begins with the Upper Paleolithic.

Along with these developments in prehistory, the study of the culture of various non-European groups around the world, including groups in the Americas, indicated that there were a number of major groupings or stages of human culture. There were simple hunting and gathering peoples, more advanced food collectors, small-scale food producers, and finally, the more advanced non-European cultures in the New and Old World which had developed complex and well integrated civilizations. In the Americas particularly, it could be seen that the cultures of the primitive groups on the marginal areas of South America and of North America contrasted sharply with the agricultural civilization of Middle and South America, or even with the agricultural groups in the American Southeast and Southwest. Physical anthropologists have indicated that there is considerable variation among the various American Indian tribes and that the Indians did not belong to a single human physical type. There were also indications that the physical type of some of the marginal peoples of the New World corresponded to the physical type of the older American prehistoric skeletal material. Studies of American Indian languages have shown that there are a great many linguistic groups in the New World. The linguistic complexity was one of the main cultural features which indicated a considerable antiquity for man in the New World. For example, it has been said that there was more linguistic diversity within the present area of the state of California than there is in Western Europe. All of the relevant data gathered by scientists on the American Indians implied that the American Indian was indeed derived from Northeast Asia and that he had probably come at a period when he was in a hunting-gathering stage of cultural development. The prevailing opinion is that the major complex agricultural civilizations, which were the wonder of the European adventurers, were developed in the New World.

The discovery of fossil man in the

The author is director of the Museum of Anthropology, University of Michigan, Ann Arbor.

Old World and of ancient Old Stone Age implements was an incentive for scholars and other people of curiosity in the Americas to search for similar materials. During the late 1800's and early 1900's there were claims of fossil men comparable to European forms and also claims of very ancient stone implement finds. There were even claims that the Indians had developed in the New World without connections to Eurasia. Critical studies of almost all of these purported fossil men and ancient implements proved that they were not of the same order of great antiquity as those of the Old World.

For some time archeologists in the New World did not think that man had been here for more than a few thousand years before Christ. In the last 30 years, however, archeological work has been able to produce sound evidence of a considerable antiquity for human cultures not only in the Americas (Fig. 1) but also in eastern and northeastern Asia (Fig. 2). Excavations in China have indicated that modern man was there in an Upper Paleolithic stage of development during the closing phases of the last glaciation. A similar situation is found in south central Siberia where man was present during the closing stages of the Upper Paleolithic and in association with extinct animal forms of the closing phases of the ice age. In North and Middle America a considerable number of finds have human implements in association with extinct American fauna and in association with geological formations attributed to the closing phases of the Wisconsin glaciation in North America.

The Siberian Advanced Paleolithic

Much of Siberia was not glaciated during the Pleistocene. Northwestern and extreme northern Siberia, as far as the Taimyr Peninsula, were glaciated as an eastward extension of the major European ice mass. The mountain areas of southern and eastern Siberia were glaciated but there were extensive areas of lowland and plateau where there was not sufficient moisture to allow for the accumulation of a continental glacier. In south central Siberia in the Upper Yenisei and Upper Lena river valleys and in the area around Lake Baikal, there are a number of sites where an Upper Paleolithic culture has been found which is best called Advanced Paleolithic, for the cultural complexes do not correspond precisely

to the sequence of culture types which have been recognized for Western Europe. These southern Siberian early cultures are directly connected with the late Paleolithic complexes to the west, and, from the evidence of faunal remains, it is known that people lived here during the closing stages of the last glaciation. The beasts that were hunted and whose bones are found in the dwelling sites are the mammoth, the woolly rhinoceros, the arctic fox, the reindeer, the cave lion, and the bison. The people lived in semisubterranean dwellings which afforded permanent shelter and a permanent camp for their hunting forays. Most of their flint tools were manufactured by striking long narrow blades of flint from carefully prepared cores. This technique is one of the diagnostic features of the late Paleolithic. Their projectile points were then narrowed toward the top with lateral retouching along one side. Their dependence upon hunting is reflected not only by the animal bones found in their dwelling sites, but also by the types of implements they made, which include a large number of flint scrapers for working hides. They also had piercers or perforators made from flint flakes, blades with very sharp points, and graving tools, for working bone and perhaps wood, which are known as burins. The smaller bones from one of their major food sources were also used to provide bone awls, long bone projectile points, bone handles for the flint scrapers and also bone needles. Effigy figures of birds and, particularly, of the pregnant human female figure were made from bone and other materials. The artifact styles and the general way of life of these early peoples identified particularly at the site of Malta (Fig. 3 and 4) near Irkutsk and Bureti in the Angara Valley are now equated with the cultural stage in Western Europe of Late Solutrean to Early Magdalenian. From the type of soil formation as well as the animals existing there, it is reasoned that the people lived in a tundra environment in south central Siberia. The period should be somewhere between 15,000 and 10,000 B.C.

Some of the Siberian sites have successive levels of human occupation. In deposits above the earliest known remains in south central Siberia, a second stage of the Advanced Paleolithic is recognized at Malta, at the Afontovo Site near Krasnoyarsk, and at a site near Irkutsk. Sites of this period are also found in the Upper Lena Valley between Lake Baikal and Yakutsk. This

second stage of the Advanced Paleolithic is connected with loess deposits, the wind-blown soil which accumulated during the warming phase or climatic amelioration which followed the final glacial retreat. These sites are also associated with indications of the initial return of forest conditions, for the charcoal in hearths is from willow and larch. The rhinoceros disappears, but the mammoth and the other cold-weather fauna are still present. From the artifacts which are found in these sites, it is thought that there is a cultural deterioration, for cruder implement types are more frequently found. There is a pronounced drop in the frequency of the long knifelike blades made from prepared cores, and there are very few pendants, or beads, or sculptures. There are large stone tools, such as scrapers or choppers, which are made from river pebbles which are flaked only along one crescentic edge. These are probably indicative of influences coming in from the chopper-chopping tool industry of eastern and southeastern Asia. Some of the projectile points are ovoid in shape and resemble bifacially flaked tools of the much earlier Mousterian stage of Europe. Some of these specific implement types are indicative of a connection with the late Upper Paleolithic and early Mesolithic or Middle Stone Age finds of Western Europe. The time period is likely to be between 10,000 and 7000 B.C. The estimates of Siberian dates are my own, based on the reported climatic changes.

The third and last stage of the Advanced Paleolithic in south central Siberia is known from sites on the Upper Lena such as Shishkino (Fig. 5), as well as in the Yenisei Valley. These sites are located in a clay soil zone immediately below the humus horizon of the coniferous forest. The climate is clearly dryer and more continental in type, and the rivers are shallow. The animal remains do not include the mammoth or polar fox, for they have moved north. Most of the animal remains are of the reindeer, with a large number of bones from horse and wild cattle. The cultural deterioration noticed in the preceding stage continues, and it is believed that this is, at least in part, the result of the climatic change from tundra to boreal forest conditions. The most common implements are the crude pebble tools which in superficial appearance look as though they belong to a much earlier cultural stage than is actually the case. The climatic condi-

tions suggest that this stage of culture was in existence from approximately 7000 to 5000 B.C.

In Europe and in the Near East following the Upper Paleolithic cultural development, the Mesolithic industries have as a primary flint working tradition the development of a small flint industry with microblades, cores, and burins. This Mesolithic stage small tool industry spreads east across the steppe and desert country of southern Siberia and Mongolia to Manchuria and to Japan. It does not seem to have established a firm foothold in south central Siberia until shortly before the introduction of more advanced imple-

ment types, such as adzes of flint, and the introduction of pottery. There are a number of sites, however, of microlithic implements from the Baikal area which are a part of the closing phases of the Advanced Paleolithic peoples. The present indications are that this cultural stage was rather localized in Siberia and of short duration. It is, of course, possible that future explorations will produce a considerably larger number of sites, and it would be particularly important if these were found in the Lena Valley. Without anything very substantial to go on in the form of evidence, it has been said that the physical type of the Advanced Paleo-

lithic population in Siberia and eastern Asia is closely related to the Upper Paleolithic Europoid types to the west.

The Paleo-Indian in North America

On the American side of the Bering Strait the Wisconsin glaciation covered most of the northern United States and practically all of Canada. Glacial ice moved down the eastern slopes of the American and Canadian Rockies and a short distance out onto the plains. In western Canada this ice advance is in contact with the moraines and other glacial debris from the large central

	NORTHWEST CANADA	HUDSON BAY	SASKATCHEWAN	MANITOBA MINNESOTA	WISCONSIN	ILLINOIS	MICHIGAN	OHIO	NEW YORK	
500	BIRNINK			ANDERSON LAUREL		LATE HOPEWELL		LATE HOPEWELL	POINT PENINSULA III	500
1 A.D.	FIRTH RIVER	DORSET II			HOPEWELL	EARLY	HOPEWELL	HOPEWELL ADENA	POINT PENINSULA II	1. A.D.
500 B.C.		TI-SITE	SANDY CREEK		EARLY WOODLAND		EARLY WOODLAND			500 B.C.
	LATE NEW MOUNTAIN	THYASZI (KNIFE RIVER)				EARLY WOODLAND	ANDREWS COMPLEX	ADENA	ORIENT POINT PENINSULA I	
1000	FISHERMAN'S LAKE		PELICAN LAKE	LARTER OLD COPPER		RED OCHRE				1000
1500	N. T. DOCKS		THUNDER CREEK	WHITE SHELL	OLD COPPER		GLACIAL KAME	GLACIAL KAME		1500
	EARLY NEW MOUNTAIN	IGLOOLIK		MINNESOTA MAN			OLD COPPER	RAISCH SMITH	LAURENTIAN	
2000	FLINT CREEK		AGATE BASIN		OLD COPPER					2000
2500	GREAT BEAR					FERRY SITE				2500
3000							OLD COPPER		LAMOKA	3000
3500						MODOC ZONE III				3500
4000	SANDY LAKE		CODY COMPLEX	BROWNS VALLEY					FLUTED POINTS?	4000
5000	FRANKLIN TANKS				PLANO POINTS					5000
			FLUTED POINTS		FLUTED POINTS	DALTON POINTS	EARLY ARCHAIC	EARLY ARCHAIC		
7000						FLUTED POINTS	FLUTED POINTS	FLUTED POINTS	FLUTED POINTS	7000
9000										9000
11000										11000

Fig. 1. Chronology chart of prehistoric complexes in northern North America.

Canadian Laurentian ice sheet which moved west. It is not known for certain whether the maximum advance of the continental sheet and the mountain

ice occurred simultaneously, or whether there was an ice-free corridor from north to south along the east side of the Canadian Rockies all through the

Wisconsin glaciation. The Wisconsin ice advance is thought by some Pleistocene students to have begun about 50,000 B.C., followed by a warmer period cor-

	WESTERN EUROPE	KANSU	SHANSI-HONAN	JAPAN	BAIKAL	MIDDLE & UPPER LENA	LOWER LENA	KOLYMA CHUCKCHI	NORTHERN & CENTRAL ALASKA	
500 A.D.								BIRNIRK	BIRNIRK	500 A.D.
1 A.D.			HAN	LATE YAYOI (Iron Age)		Iron Age	Iron Age		OLD BERING SEA	1 A.D.
1500	Iron Age			EARLY YAYOI		KULLATY I (Bronze)	BRONZE	WELEN-OKVIK		1500
1000			CHOU		SHIVERA	YMYAKHTAKHI		CHIROVOYE?		1000
1500		SSU-WA	ANYANG (Bronze)	LATE JOMON		KULLATY II	KYLARSA			1500
2000		ESIN-TIEN MA-CHANG	FU-CHAO-CHAI		GLASKOVO	TURUKTA KULLATY III	KYRDAL UOLEA LAKE	POMASKINO		2000
2500	Bronze Age	PAN-SHAN	HOU-KANG I YANG SHAO	MIDDLE JOMON	SEROVO	BESTYAKH	CHOKIROVKA?		DENBIGH FLINT COMPLEX	2500
3000	LATE NEOLITHIC EARLY NEOLITHIC	EARLY NEOLITHIC	EARLY NEOLITHIC	EARLY JOMON	ISAKOVO				ANUKTUVAK PASS CAMPUS SITE	3000
3500										3500
4000	LATE MESOLITHIC				KHIN					4000
5000										5000
6000					VERKHOLEN- SKAIA GORA					6000
7000						MAKAROVO				7000
8000	EARLY MESOLITHIC				AFONTOVA II					8000
9000						CHASTINKA				9000
10000					MALTA- BURETI					10000
11000	LATE MAG- DALENIAN									11000

Fig. 2. Chronology chart of prehistoric complexes in eastern Asia and north-central Alaska.

responding to the Würm interstadial in Europe. This may have provided an ice-free corridor east of the Rockies some 30,000 years ago. The furthest south ice advance which produced the glacial stages in the Great Lakes area during the Wisconsin reached as far as central Illinois about 23,000 B.C. and may have closed the postulated gap in western Canada. It is highly probable that by at least 12,000 to 14,000 B.C. there was a corridor between the mountain and continental glacier in western Canada which would have allowed access from northern Alaska and northwestern Canada to the plains area to the south.

There are a number of finds which support the argument that man may have been in the New World, particularly in the western part of North America, some 30,000 to 20,000 years ago. The evidence for man at this time is, however, not completely convincing, and the majority of American archeologists are hesitant about accepting it. The reason for hesitation varies from find to find. If a clearly defined cultural complex is radiocarbon dated and is in agreement with the correct geological formations and faunal associations, then certainly the majority of American archeologists will be willing to accept such evidence. If early man did come in and occupy the North American continent 20,000 or 30,000 years ago, it would mean that he must have come in during the interstadial between the early and later Wisconsin glaciations or in pre-Wisconsin times, or both. This would imply that the physical type of man associated with such early finds could be very close to Neanderthal in appearance. It would further imply that the cultural type associated with man at this stage would be one resembling the Mousterian of Europe, or the chopper-chopping tool industry of eastern Asia. Neither man nor cultural material has been found in sites of the required age in southern and eastern Siberia.

We are certain that the earliest American Indians were in the United States area by between 10,000 to 12,000 B.C. This is based on radiocarbon dates of some 11,000 years ago from the Rocky Mountain areas in the west and the implied evidence that man was in the southeast and eastern part of the country at approximately this same time. Furthermore, the degree of cultural diversity between finds in the west and in the east are an indication that no small time must be allowed for

such a differentiation of culture types in the New World. While there are no skeletal remains clearly associated with the most ancient definite cultures in the New World, there are crania with an antiquity of around 8000 B.C. which are of the same general physical type as that thought to be associated with the Advanced Paleolithic cultures in Siberia.

Our best evidence of man in the period from 10,000 to 12,000 years ago is in the general High Plains area where the economy was that of a hunting-gathering people with heavy emphasis upon the use of game animals for food and for clothing. The general way of life in America was very much

the same as in the early Advanced Paleolithic culture of Siberia. Many of the beasts which were hunted are similar, for the mastodon and the mammoth, the bison, horse, camel, and other such herbivores are found associated with remains of early man. The early American hunters of the east and west had about the same inventory of flint artifacts, such as the scraper, the perforator, and the graver, but not the burin, and probably very similar bone implements. These Paleo-Indian hunters did not make their projectile points from carefully prepared blades which were struck off from carefully shaped flint cores, but instead produced their projectile points from large flakes struck

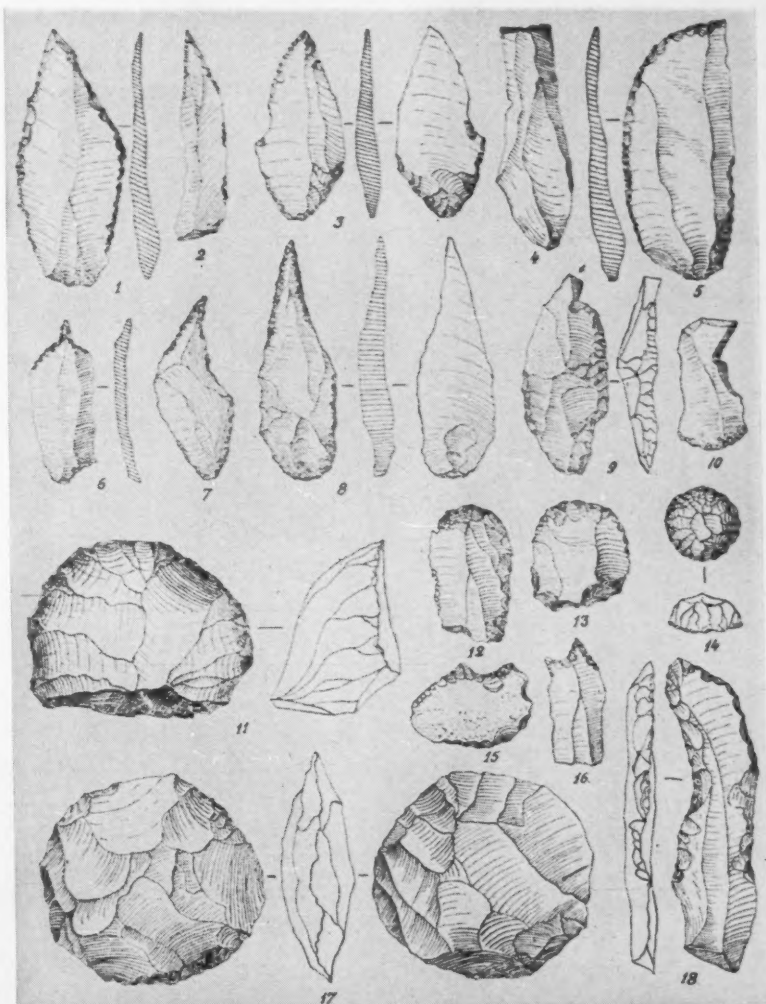


Fig. 3. Flint tools from the early level of the Malta Site, Siberia. 1-3, Points worked on one face only; 4, blade with transverse retouch; 5, blade with curved edge; 6-8, perforators; 9, 10, burins; 11-14, scrapers; 15, 16, concave scrapers; 17, disk-shaped implement; 18, notched blade. [From Bonch-Osmolovsky and Gromov (6)]

off from flint blocks. They also did not make human figurines. A significant new development is the production of bifacially flaked projectiles which have long flakes removed from both faces of the point by means of very careful and excellent chipping techniques from the bases of the projectile (Fig. 6). This carefully controlled technique of bifacial flaking is one which does not appear in the Siberian area until close to the Neolithic and is one of the reasons why

some of the prehistorians were loathe to accept a high antiquity for these finds in North America. It must be assumed, on the basis of present evidence, that the culture trait is primarily an American development, along with the distinctive fluting which removed flakes from both faces of the projectile.

Mary Haas has recently presented the view that the Muskogean and Algonkian languages which almost blanketed the area east of the Mississippi are descendants of an ancient common

language of some 8000 or more years ago. This could mean that the Paleo-Indian hunters of the east spoke related dialects of a common language and that the marked linguistic diversity of modern times was initiated during the long Archaic period.

We have seen that at the close of the Pleistocene in southern Siberia an Advanced Paleolithic culture was established with a Europoid physical type, and with the amelioration of climatic conditions there was a tendency for the cultural type to deteriorate. It may be that as the climatic conditions were modified, people hunting the big game animals followed the animals northward into the tundra ecological zone and on to a much wider Siberian coastal plain which would have been in existence at that time, because of the lowering of the sea level. From there they could have moved eastward across the Bering Strait, where a land bridge would have been in existence some 10,000 to 15,000 years ago, and thence moved to the valley of the MacKenzie (1). The northern section of Alaska north of the Brooks Range and a significant area of the Alaskan coastal shelf were tundra vegetation at this time, and unglaciated. This is also true of the Seward Peninsula area and the Chukchi Peninsula. They would still have been in a tundra ecological zone in their spread up the MacKenzie until they came into the prairie grassland areas of the eastern slopes of the American Rockies. It is also possible for man to have moved from the Seward Peninsula area into the boreal forest of the Yukon, up the Yukon Valley to the east and southeast, and finally to have come into the MacKenzie Valley and northern plains in northern Alberta and northeastern British Columbia.

From about 10,000 to 8000 B.C. the Paleo-Indian fluted-blade hunters occupied most of the United States east of the Rocky Mountains and south of the retreating Wisconsin ice. These Paleo-Indians seem to be the earliest people east of the Mississippi. There are distinctive local complexes and a number of significant variants in the shapes of the fluted projectile in the east. 8000 B.C. may be said to be a convenient dividing line between the Paleo-Indian and the Early Archaic culture of the east, because after this date the fluted projectile style tends to disappear and most of the Wisconsin ice has moved north of the Great Lakes.

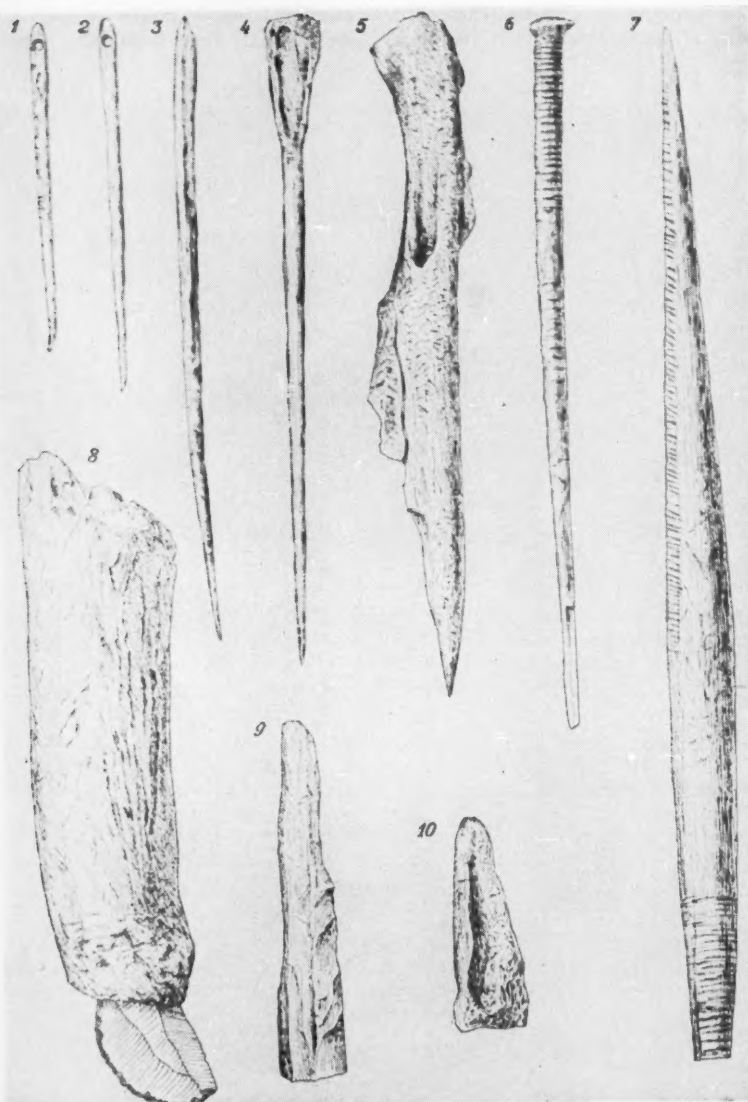


Fig. 4. Bone and antler objects from the early level of the Malta Site, Siberia. 1, 2, needles; 3-6, points or awls; 7, spearpoint with beveled proximal end; 8, reindeer antler haft and scraper; 9, 10, worked bone fragments. [From Bonch-Osmolovsky and Gromov (6)]

The American Archaic

The Early Archaic of 8000 to 4000 B.C. is a continuation of the hunting-gathering way of life. There are increasing indications of regional differences reflecting local ecological and climatic zones. A wider variety of projectile forms are known and heavy chipped stone choppers or diggers are found. During this period the seasonally migrating small bands of people were becoming familiar with the native mineral, animal, and plant resources. Many of the major flint quarries were discovered, and certain spots were selected as seasonal camping grounds, where deep refuse deposits bear witness to their intermittent occupation.

In the western plains the Plano cultures are known during the Early Archaic period. They had a pronounced emphasis upon hunting both the large extinct bison form, during the early Plano, and the modern bison at a later time. The prairie hunting adaptation spread north into Alberta and Saskatchewan with the return of the grassland to those areas. The long, slender,

beautifully chipped projectiles of the several Plano styles are known as far east and north as southern Manitoba, along the shores of glacial Lake Agassiz, on the north shore of Lake Superior on a high ancient beach ridge, and as far as northern Lake Huron.

Up to about 4000 B.C. the cultural developments in the east are primarily of American origin and are part of natural cultural changes. Between 4000 B.C. and about 1500 B.C., however, there are new artifact types which have both formal and functional resemblances to northern Eurasian forms. Prominent among these are the gouge and the adze in the Great Lakes to New England region and the grooved axe in the area from the Ohio Valley to northern Alabama. These heavy, wood-working tools are of ground stone and may have had their prototype in chipped flint and stone choppers known in Early Archaic sites. Other artifact similarities to northern Eurasia are various ground slate, knife, spear and projectile forms in sites from New York to New England, and almost identical forms made of native copper from the

Wisconsin-Michigan area. It is possible that some of these artifacts of slate and copper are copies of bone and flint implements.

The artifact similarities of the gouges, adzes, and slate forms are closest between the New York-New England area and northern Scandinavia and Karelia, where on sites indicative of some antiquity the gouge, adze, and slate forms are well represented. The present tendency is, however, to date these forms in extreme northern Europe at about the same time period that they are known in the northeastern United States. One of the adze forms from Karelia is very much like the beveled Lamoka adze in New York of 2500 to 3000 B.C., but it is not found east of the Ob River in western Siberia. These artifacts have often been referred to as a part of an eastern circumboreal spread, but they do not have sufficient continuity across Siberia, Alaska, or northwest Canada at a sufficiently early period to support either a suggested movement of people or diffusion from the Old World to the New. Of the two possible explanations of cultural move-

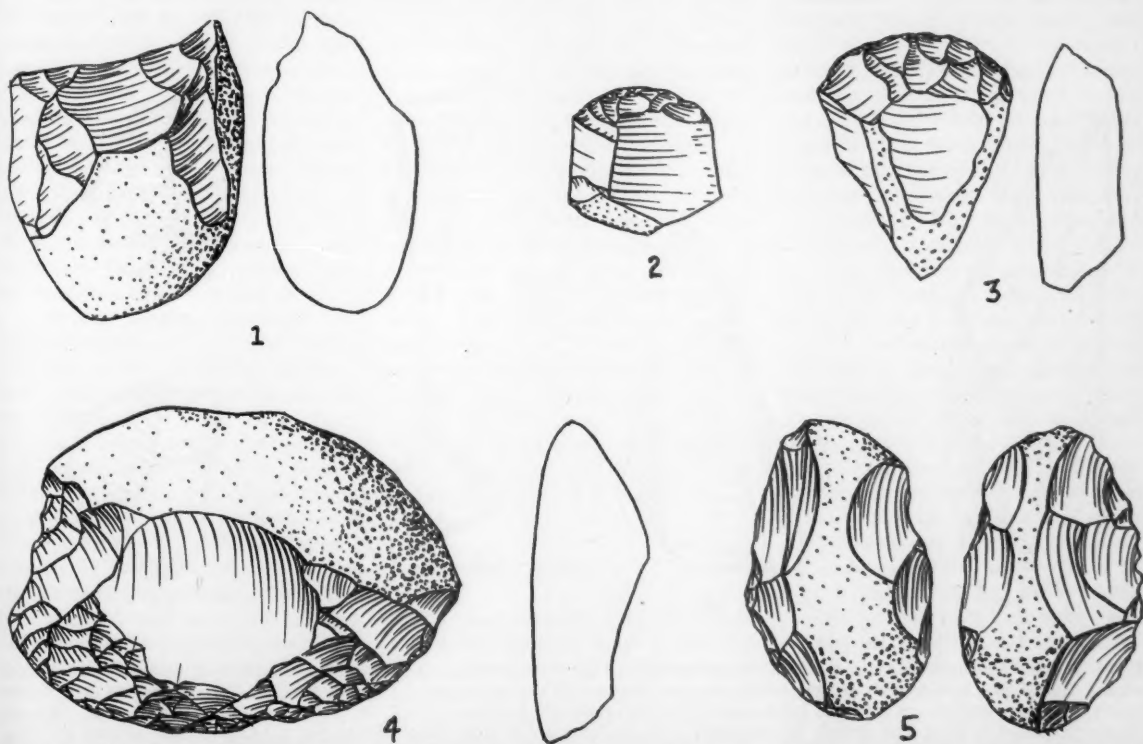


Fig. 5. Flint tools from Shishkino, a late Paleolithic site in the Upper Lena Valley. 1, 4, 5, Pebble core scrapers or choppers; 2, 3, end scrapers. [After Okladnikov (2)]

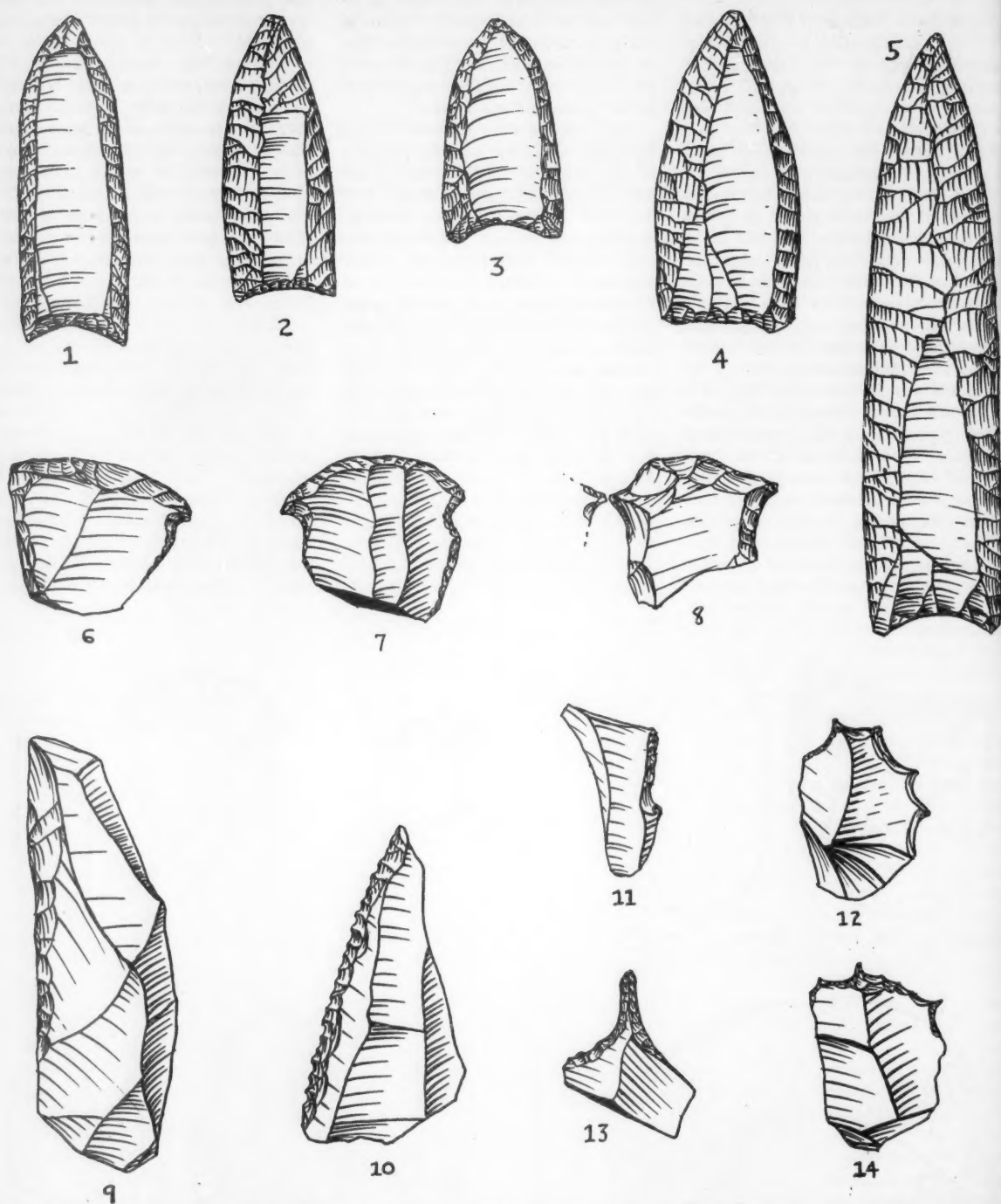


Fig. 6. Selected flint implements of the fluted blade complex in the United States. 1-5, Fluted projectile points from western and eastern United States; 6-8, end scrapers combined with gravers; 9, 10, side scrapers; 11, used flake; 12-14, gravers and drill. Implements 1, 6, 9, 11, and 13 are from the Lindenmeier Site, Colorado (7). Implements 2, 7, 10, and 14 are from the Quad Site, Alabama (8). Implement 4 is from Bull Brook, Massachusetts (9). Implement 5 is from Black Water No. 1 locality, New Mexico (10). Implements 3 and 8 are from Michigan. [Museum of Anthropology, University of Michigan]

ment, slow diffusion would appear to be the best hypothesis, which future excavation may document.

There are many polished stone forms which also serve to characterize the Late Archaic in the east. Among these are banner stones, boat stones, and birdstones. These are believed to have been attached to the throwing stick which acted as an added lever to propel the spears during the hunt. These forms have no known Old World or American arctic counterparts. The wide variety of projectile forms and other flint and bone implements of the Late Archaic are best regarded as local developments. The projectile forms particularly cannot be derived from Siberian or American arctic prototypes.

The Arctic Denbigh Complex

If a satisfactory demonstration of cultural movement from Siberia to eastern North America cannot yet be made, which would strongly affect the Late Archaic cultures, there is abundant documentation (in the archeological sense) for a significant cultural spread from Siberia to the American Arctic from about 3000 B.C. to 1500 B.C. As already indicated, following the Advanced Paleolithic stage in Siberia there is a movement into southern Siberia from the south of the small tool complex of blade, core, and burin and small, bifacially flaked arrowpoints, which make their appearance before the introduction of pottery. By the time this complex is known to have reached the Middle and Lower Lena, however, pottery is always associated with it.

In Alaska, however, this small tool complex is known from a series of sites from the Brooks Range to the Aleutians where pottery is not in association. The complex is best known from the stratified Iyatayet Site at Cape Denbigh, on the south side of the Seward Peninsula (Fig. 7). In addition to the small flint tool complex, there are a large number of beautifully flaked projectile-point forms which have been compared with Plano points, and it has been suggested that these have diffused to the Seward Peninsula from the northern plains. It is also possible that they are a local development based on the bifacially flaked points and side blades of the early eastern Siberian Neolithic. This suggestion is favored in this article because the Denbigh complex also has

small bifacially flaked triangular arrow or harpoon points which are very much like the Siberian Neolithic points.

Former assessments of the age of the Denbigh complex have usually been to a period from 8000 B.C. to 4000 B.C., based on the interpretation of geological evidence and a natural inclination to connect the small core, blade, and burin with the Eurasian Mesolithic culture, and as close to that time period as possible. Such an antiquity was never completely acceptable. The view presented in this article is that the lower occupation level at Iyatayet was in existence at 2000 B.C., and this is supported by a series of radiocarbon dates from the site. The core-blade and burin may have appeared in Alaska somewhat earlier. The Denbigh small tool complex, with variations, does spread to the east, where it has been found on the Firth River in extreme northwest Canada; from Knife River in northeastern Manitoba; from the Melville Peninsula; and as far east as Disko Bay in central-western Greenland. The location of some of these sites in the area around Hudson Bay are such that they could not have been occupied because of ice, or later marine submergence, at an age compatible with a high antiquity for the Denbigh complex. On the other hand, the spread of this complex into the central and eastern Canadian tundra between 2000 B.C. and 500 B.C. would be geologically completely feasible.

While the full Denbigh complex does not penetrate into the Great Lakes area and the northeast, the core and blade technique, but apparently not the burin, does appear in the Lower Mississippi Valley in the form of the microflint industry of the Poverty Point culture. The radiocarbon dates for this introduction would be somewhere around 1000 to 500 B.C. Larger blades struck from a variety of core types are a diagnostic feature of the Hopewell culture of the Upper Mississippi and Ohio Valley and of Point Peninsula II in New York.

The Siberian Neolithic

The most striking and widespread prehistoric material culture trait of eastern North America which can be attributed to an origin in the Siberian Neolithic is the Woodland pottery tradition which covered a wide area from the Rocky Mountains to the Atlantic, and from the Gulf of Mexico to south-

ern Canada. In Canada, Woodland pottery is known from southeastern Alberta to southern Quebec and Nova Scotia. For many years the majority of American anthropologists believed that all of the prehistoric pottery of the North American Indians was derived from Mexico and was associated with the northward spread of American agriculture. This view is gradually being abandoned in favor of an Asiatic origin.

The earliest known eastern Siberian Neolithic is in the Baikal area, according to Russian archeologists, and their use of the word "Neolithic" indicates the presence of pottery, ground and polished stone tools and ornaments, arrowheads, and other bifacially chipped flint forms, but does not mean that agriculture was practiced. The most experienced Russian excavator in central and eastern Siberia and the most prolific producer of papers on the area is A. P. Okladnikov (see 2). Many of his papers have now been abstracted or interpreted by American scholars. Parenthetically, it may be observed that Okladnikov is conversant with the American archeological literature.

There are three sequential premetal archeological phases in the Baikal, which are named Isakovo, Serovo, and Kitoi. Some traits of the postulated earlier nonceramic Khinskaya culture persist, such as small cores and blades, and the bifacially chipped arrowpoints which become much more common. Some of the characteristic traits of Isakovo are given below. The arrowpoints are trianguloid with a concave base and asymmetrical barbs. One of the distinctive traits derived from Mesolithic cultures to the west is a long bone point which has slots along the sides for the insertion of flint side blades. They are identified as spears, and similar but shorter forms are called daggers. There are composite knives of large side blades inset into bone handles, large flint ovoid and elliptical scrapers, chipped and ground slate and nephrite knives, and large chipped and partly ground adzes and gouges. The pottery has a shape like the lower half of an egg. It is low fired, relatively thin (about 5 mm), was tempered with crushed rock, and was, of course, hand-made. The vessel exterior is covered with net impressions made while the clay of the shaped vessel was still plastic. Impressions made from these pottery fragments clearly show the net knots and connecting threads. Okladnikov

kov thinks that the Isakovo vessels may have been made in net-lined pits in the ground. The pottery of the succeeding period, however, is clearly coiled or ring-built and then paddled to apply a variety of surface finishes. The use of small paddles is well documented ethnologically and archeologically throughout the distribution of the Siberian Neolithic and in North America. It is one of the important concepts as to how pottery should be made on this primitive level. Okladnikov has proposed a time period of 4000 to 3000 B.C. for the Isakovo phase of the Lake Baikal sequence, but in the chronology of this article, it is placed at 3000 to 2500 B.C.

The succeeding Serovo phase continues many of the earlier cultural traits, but with some significant additions and changes. The basic pottery form takes on a more rounded base and small, thick lugs, which may have been used for suspension. The most common surface treatment is still with a net, but the surface was usually smoothed over before the vessel was fired. A new decorative treatment is presumably derived from the comb ceramic areas to the west. These dentate stamp impressions were apparently made with small, narrow, slate fragments with grooves cut across the edges. Around the outer rim of the vessel there are one or more horizontal rows of small bosses or protuberances made by pushing a small rod into the inner wall and forcing the boss to appear on the outside. Polished stone knives increase in number and variety of form. Polished stone fish effigies were used as lures. The chipped flint adzes and gouges are well polished. Unilateral and bilateral barbed bone harpoons are found for the first time, as are barbed bone fishhooks. A distinctive braced or composite bow is unique to the Serovo phase, and comes in with small stemmed arrowheads. Most of the arrowheads are small triangular forms. The archeological evidence, then, suggests a strong emphasis upon fishing in the Serovo culture, for beside the spears, harpoons, and fishhooks, nets were used. There are bone and antler flakers with which the Serovo people produced long side blades with ripple flaking for bone daggers and spears, as well as long flint knives and daggers, some of them also with parallel oblique ripple flaking.

Okladnikov has suggested that a reasonable estimate for the age of the Serovo phase would be 3000 to 2000 B.C. In the chronology adapted here the dates are 2500-2000 B.C. This may

be somewhat too early, particularly if published statements on the presence of cord-marked and linear stamped pottery in Serovo are true (3), but I have not been able to verify this from the translations available or from illustrations. The age of the early Baikal Neolithic is not firmly established. On the hypothesis that the ceramic tradition of this area should be allied to, and in part derived from, the Early Neolithic pottery in the belt from China to Japan, the presence of a number of types of surface finish, such as cord-marked, linear stamped, and check stamp, should not be earlier in the Baikal and Lena valleys than it is in China. The Isakovo pottery does not have a direct ancestor in northern China, but would not precede the introduction of pottery into China on an early, simple "Neolithic" level. China may be regarded as a primary center for the hypothetical Early Neolithic, as it was for the subsequent Late Neolithic of the Yangshao and Lungshan complexes, and for succeeding cultural developments.

The Kitoi phase of the Baikal sequence certainly has cord-marked pottery, but the dominant decorative devices are dentate stamp, punctates, and linear punctates. These are placed on the outer rim in vertical, horizontal, or zigzag patterns. The use of linear punctate with raised rim patterns is reminiscent of certain Japanese styles such as the Shiboguchi type (4). Distinctive new traits are three-stop bone flutes and bone "panpipes." While bone flutes are a part of the Late Archaic in the eastern United States of at least 2500 B.C., panpipes are not known until the Hopewell culture of around A.D. 1. Another new Kitoi trait is the free use of red ochre in graves, either on flexed burials or cremations. An increased emphasis upon fishing is indicated by large numbers of composite fishhooks. Harpoons are unilaterally and bilaterally barbed, and many of them have perforations for a line attached through a flange near the base of the harpoons. Side-bladed knives, spears, and daggers continue, as do the adze and gouge. The true celt makes its first appearance in the Kitoi phase. A distinctive, narrow, hammerheaded bone point has been likened to those from pit and catacomb burials of southern Russia and from a Bronze Age site in Scandinavia of about 1800 B.C. There is an increased use of ground and polished nephrite for knives, points, adzes, and axes. Bone

bracelets, pointed instruments, and needle cases are decorated by incised circle and dot decoration, which is also present in Eastern European Bronze Age sites. While Okladnikov suggests a time period from about 2500 to 1750 B.C., in this article Kitoi is placed between 2000 and 1500 B.C.

While actual metalworking is not known in the next phase, Glaskovo, it is clear that it is temporally on the same level as the Bronze Age cultures to the south and west, while by the following Shivera phase local metallurgy is known in the Baikal area.

The Middle Lena Neolithic complex is significantly different from the Baikal area for a number of reasons. The majority of the ceramic-bearing sites in this area are associated with a strong element of small cores, blades, and burins, as well as the small bifacial arrows, and side blades. Either this small flint-tool complex has survived from an earlier local unidentified nonceramic phase, or it may have moved into the Yakutsk area from Manchuria. This latter area seems to have furnished many ceramic elements such as the check stamp, linear stamp, and cord-marked surfaces, which tend to supersede the Baikal-derived, net-impressed surfaces. Another possible ceramic trait from Manchuria is seen at the site of Kullaty, where some of the vessel rims are thickened and incised with horizontal lines. There may also be some vessels which had a woven fabric impressed against the walls of the vessel. This type of surface treatment may resemble that from the eastern United States, or it may be more like fabric or cloth impressions from an early ceramic site of about 500 B.C. on the north side of Seward Peninsula (5). The dentate stamp is also significant as a decorative device. The developed Neolithic of the Middle Lena is regarded in this article as being about 1500 B.C. This area and the Lower Lena would seem to be the major known concentration of Neolithic pottery which is directly ancestral to the Norton pottery of the Seward Peninsula and the Firth River pottery of north-western Canada.

In the Lower Lena Valley some of the earliest known sites have long trihedral points with short stems, or stemless forms, which are very similar to those of the Lake Onega area of north-western Russia, where they are said to date between 2000 and 1500 B.C. In general, the flint industry resembles that of the Middle Lena, with an em-

phasis on burins, small cores and blades, triangular bifacial arrowheads, side-blades, semilunar knives, and a few chipped and polished adze fragments. The pottery includes cord-marked, check and linear stamp, and dentate stamping. Because of the large size of the squares on much of the check stamp pottery, and the organic temper, most of this pottery would seem to be quite late. This is based on the late time position of these traits in western Alaska. There are other sites between the Lena and the eastern part of the Chukchi Peninsula. They have not been fully excavated or reported, and additional work will be required to adequately document the cultural movements which must have taken place into Alaska.

The earliest described pottery in Alaska is the Norton complex at the Iyatayet and related sites in western Alaska. This complex is directly derived from the Lena linear stamped and check stamped types. In turn, Norton is the western progenitor of the Firth River pottery in northwest Canada, where it has been reported that in addition to the Norton types of surface finish there are also dentate stamp and cord marking. The Norton complex is dated a few hundred years either side of A.D. 1, and the Firth River pottery should be

about the same age. This early pottery in the American Arctic is associated with a flint industry of Denbigh complex origin. The pottery is not known to have moved south through the Boreal forest into the Great Lakes area, nor has any other early ceramic complex appeared in that area.

The Transitional and Early Woodland Complex

During the period of 1500 to 500 B.C., there are a number of new cultural developments in the northern part of the eastern United States. This time period can be called Transitional between the Archaic and the Woodland cultures or regarded as Early Woodland, particularly when pottery is associated with the rest of the culture. One of these developments is the increased attention to mortuary observances in the Red Ochre, Glacial Kame, Point Peninsula I, and Red Paint phases from Illinois and Wisconsin to New England.

There is a marked emphasis upon the burial of cremated human remains in excavated pits. These burials are accompanied by a variety of the polished stone forms mentioned above and caches of projectile forms, which show a marked preference for triangular

points. Another feature was the custom of burying fire-making sets of iron pyrites and a flint striker. The pyrites is usually found as yellow limonite. This is the period of the first certain recognition of percussion fire making, and should be connected not only with the historic distribution of this method in the northeast and American Boreal forest and Arctic, but should also be derived from Eurasiatic percussion techniques which are certainly known during the Neolithic and Bronze ages, and probably earlier as well. The grave area, the artifacts, the skeletal material, or the cremated bone were covered with a considerable amount of red ochre.

To each of these local complexes is added the earliest known Woodland pottery, which is thick, very coarsely tempered with large particles of crushed rock. The vessels are either cord-marked on both the inner and outer surfaces or, more rarely, may be smoothed on both surfaces. The vessel shapes are conoidal, rounded on the base, or flattened. This early variety of Woodland pottery belongs to the same tradition as the early arctic pottery, but a close counterpart is not known either in America or Asia. Perhaps this is another example of stimulus diffusion, where knowledge of a particular technology moves across a geographical

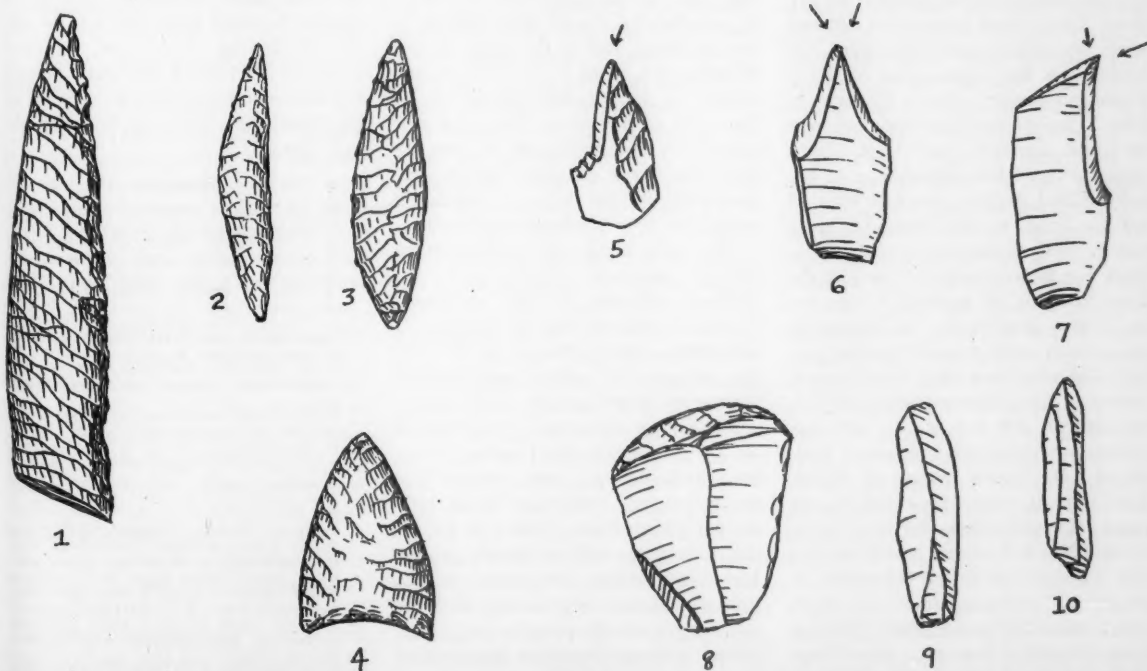


Fig. 7. Flint implements of the Denbigh complex from Cape Denbigh, Alaska. 1, Side blade about 3.3 cm long; 2, crescentic side blade; 3, plano-convex point; 4, small triangular point (harpoon or arrow?); 5, small angle burin; 6, chisel burin; 7, angle burin; 8, small end scraper; 9, 10, retouched lamellar blades. [Drawn from illustrations in Giddings (11)]

area, in this case, from the extreme northern American Arctic to the Great Lakes; and it appears in a variant form without a specific prototype in the Arctic. In any event, knowledge of and the manufacture of pottery spreads south. From the Ohio Valley to the Tennessee Valley the earliest pottery has a fabric-impressed surface and a conical or flat base. The textile which was employed had a wide warp and closely woven weft threads of twisted bast fibers. It is not coiled basketry, nor was the pottery made in a basket. In Georgia the Early Woodland pottery is fabric-impressed, dentate stamped, or simple stamped, with linear impressions somewhat like the Siberian and early arctic American linear stamp. Once the concept of using a carved paddle instead of a cord or fabric-wrapped paddle was adopted in the southeast, there developed a center of check stamp and complicated stamp designs with a great many striking similarities to the pottery of the eastern Chinese area during the Chou and Han dynasties. These similarities can be regarded as parallel developments based on the common possession of a general technique or tradition as to the correct manner of pottery manufacture.

A number of examples will help to demonstrate that formal resemblances between Asiatic and American pottery are not always to be regarded as evidence for a direct connection between these two widely separated areas. Following the first appearance of Early Woodland pottery around Chesapeake Bay, a net-impressed pottery becomes the most common type. It is almost identical in surface appearance to the early Baikal pottery, but this style of surface finish is not found on early pottery between the Lena and the Potomac. The linear stamped pottery of the Late Neolithic of northern China has its closest parallel in the post-1200 A.D., Plains area grooved paddle pottery. The zone-decorated, fine Hopewell pottery of the northern Mississippi Valley between 200 B.C. to A.D. 250 has its closest stylistic resemblance in Middle to Late Jomon pottery of Japan. This style is not represented in the pottery of northeastern Siberia or northwestern North America. A very distinctive stamped design is composed of groups of adjoining small diamonds with a raised dot in the center. This has been recognized from sites near Hongkong and from Manchuria and probably belongs to the Chou to Han periods in eastern Asia. An almost identical

design is found only in America from Early Woodland sites near Savannah, Georgia.

Another significant cultural addition of the 1500 to 500 B.C. period is the trait of burial mounds in the Illinois and Ohio valleys which begin as small, low, dome-shaped earth constructions over a burial complex analogous to the specialized interments of the Transitional period mentioned above. The mound burial ceremonialism develops over a thousand-year period to about A.D. 500, and very large complex burial mounds containing hundreds of burials were erected by the Adena and Hopewell cultures. Burial mounds are distributed over a wide area in Eurasia but are not a part of Neolithic or Bronze Age sites from the area east of the Upper Yenisei to the very late mound constructions of southern Manitoba.

A number of perishable products made their first appearance in eastern America about 1500 to 500 B.C. Among these are skin bags, thread, simple fabrics, nets, and fish weirs. They were probably also in use during the Archaic but were not preserved.

During the Archaic the skull form of the burials is predominantly long-headed. A number of regional variants of this archaic population are recognized but not clearly defined. During the Late Archaic and Early Woodland a roundheaded cranial type appears in the northeast and in the Ohio Valley. Whether this is the result of a gradual change in the resident population or the result of the introduction of a new population from the south or from the northwest is not definitely known. One possibility is that it is a population movement from northeastern Siberia.

The most significant cultural event which gradually transformed the Archaic societies to the developed Woodland cultures was the addition of agriculture from Mexico. From 500 B.C. to A.D. 500, gourds and perhaps corn were added to the food supply. There are, in addition, a few traits of the developed Woodland culture which are clearly derived from Mexico. The last major prehistoric stage in the Mississippi Valley from about A.D. 800 to the historic period is known as the Mississippi pattern or culture. It was strongly influenced by concepts of Mexican origin which were in turn integrated and developed in the eastern United States for 800 years into the distinctive cultural forms of the early historic period.

Summary

The prehistory of the American Indian in the eastern United States, in spite of an impressive amount of excavation and study, is still in an unsatisfactory state, even though the major outline of cultural change and development is known. The earliest food collectors of the area, the Paleo-Indians, possessed a culture type of more or less close connection to the Siberian Advanced Paleolithic groups. During the long Archaic period from 8000 to 1500 B.C. a variety of minor culture changes and adaptations take place which are primarily developments of the native American populations. There may well be significant increments from Asia during the Late Archaic, as has been postulated for the heavy woodworking tools such as the gouge and adze, but to definitely establish such influences, their manner of spread needs to be adequately documented.

There are a number of cultural traits which appear in the eastern United States between 1500 to 500 B.C. which are best explained as the result either of diffusion from Asia or to some degree also by population movement. These are added to the resident culture and this merger, along with agriculture and influences from Mexico, produced the developed Woodland cultures of eastern America from 500 B.C. to A.D. 500. Following this period, Mexican influences, but not a migration, shaped the dominantly agricultural societies of the Mississippi Valley in the early historic period.

References

1. D. M. Hopkins, "Cenozoic history of the Bering land bridge," *Science* 129, 1519 (1959).
2. A. P. Okladnikov, "Traces of the Paleolithic in the Valley of the Lena," in *Materials and Researches in the Archaeology of the U.S.S.R.* (in Russian) Moscow (1953), vol. 39.
3. P. Tolstoy, "The archaeology of the Lena Basin and its New World relationships, part II," *Am. Antiquity* 24, pt. 1, 63 (1958).
4. G. J. Groot, *The Prehistory of Japan* (Columbia Univ. Press, New York, 1951), plate XI.
5. J. L. Giddings, "Round houses in the western arctic," *Am. Antiquity* 28, pt. 1, 121 (1957).
6. G. Bonch-Osmolovsky and V. Gromov, "The Paleolithic in the Union of Soviet Socialist Republics," *Intern. Geol. Congr. Rept. of XVI Session, U.S.A., 1933* (1936), vol. 2, pp. 1291-1311.
7. F. H. H. Roberts, "Additional information on the Folsom complex," *Smithsonian Misc. Collections* 65, No. 10 (1936).
8. F. J. Soddy, "The Quad Site, a Paleo-Indian village in northern Alabama," *Tenn. Archaeologist* 10, No. 1, 1 (1954).
9. S. Byers, "Bull Brook—a fluted point site in Ipswich, Massachusetts," *Am. Antiquity* 19, 343 (1954).
10. E. H. Sellards, *Early Man in America: A Study in Prehistory* (Univ. of Texas Press, Austin, 1952).
11. J. L. Giddings, "The Denbigh flint complex," *Am. Antiquity* 16, 192 (1951).

Hybrids of *Escherichia* and *Salmonella*

The genetic homologies of these bacteria are determined by mating and transduction.

Norton D. Zinder

Baron *et al.* (1) and Miyake and Demerec (2) have reported the hybridization of *Escherichia coli* Hfr with certain strains of *Salmonella*. The Hfr strain of *E. coli* donates part of its genome to the recipient *Salmonella*.

By introducing *E. coli* genes into *Salmonella*, it is now possible to begin to observe whether there are any homologies of the genetic material in these closely related organisms. For studying the macrohomology, with respect to chromosomes or segments of chromosomes, recombination itself is available. For studying the microhomologies, the process of transduction is available.

Methods

The derivatives of *E. coli* K-12 used were strains Hfr (Cavalli) (3) and Hfr (Hayes) (4) and an F+ strain. The *S. typhimurium* strain was a derivative of LT7 (5), obtained from Miyake (2).

Suitable mutant genes were introduced into these strains for the particular purposes of the experiments. They are described below. The symbols used are as follows. For auxotrophic mutants, "meth" refers to methionine, "leu" to leucine, and "try" to tryptophan. For fermentation mutants, "gal" refers to galactose, "lac" to lactose, and "arab" to arabinose. Drug resistance to sodium azide is symbolized by "az." In addition, superscript "s" or "c" is used when necessary to indicate whether the allele in question was derived from *Salmonella* or from *E. coli*.

The techniques used for obtaining the mutant alleles and the media employed were those described by Lederberg (5).

The author is affiliated with the Rockefeller Institute, New York, N.Y.

Bacterial crosses and transduction were accomplished by the routine procedures described by Lederberg *et al.* (6) and Zinder (7, 8), respectively.

Experiments

Recombinational analysis and macrohomologies. Figure 1 shows the region of the *E. coli* chromosome with which we are concerned. It is the map that was obtained when strain Hfr (Cavalli) was crossed with strain F- coli. The orientation of the chromosome is as shown, with the T6 lac region entering first. There is therefore immediately available a very potent selective marker in this region, since salmonella are by nature lactose nonfermenters and do not mutate to lactose fermentation. The meth locus in the Hfr is outside the region transmitted to the F-, and the means to select against the coli parent is thereby provided. The cross then is lac+ meth- coli by lac- meth+ salmonella when the bacteria are placed on a minimal medium containing lactose as the only carbon source. The selection is for meth+ lac+. By introducing, prior to crossing, the mutant alleles of the genes presumed to be located in this region, it is possible to look at the general linkage structure. It is significant that when the cross is set up as described, recombinant progeny appear at the lower frequency characteristic of F+ by F- matings in coli, not at the frequency of Hfr by F- matings. However, hybrids will, upon backcross to Hfr coli, give a high frequency of recombinants and even yield progeny when mated with F+ coli. It might be that only special cells of the salmonella population can mate with coli and that these are selected by the first

round of mating, as has been proposed by Baron *et al.* (1). It is not known whether the selection would be for greater mating capacity or greater integration capacity.

Table 1 gives the data for two sets of crosses for markers in this region. Since salmonella lack the receptors for the coli bacteriophage T6, another marker is available. Almost all of the progeny obtain the coli T6 marker. This is manifest by the fact that they are killed by infection with a multiplicity of T6, but still they do not propagate this bacteriophage. One further naturally existing marker lying in this region is of some import. It is one that produces a host-controlled modification (9) of phage P22. Since P22 does not attach to coli strains, nothing can be said about its growth on these strains. However, when P22 is grown on the majority of the hybrids it undergoes modification such that it grows well on the hybrid (the determinant is defined here as Mp^c) but only with an efficiency of 10⁻⁴ on salmonella (Mp^s). The modification is nonsymmetrical, as P22 grown on Mp^s bacteria grows equally well on the two alternative bacteria. The Mp locus seems to be between T6 and lac, as some of the few progeny that did not obtain T6^c did not obtain Mp^c. It should also be noted that the vast majority of the progeny selected in this way retain all of the characteristic salmonella antigens, and hence it might be assumed that the genes controlling these properties lie elsewhere in the genome. There are, however, some serological hybrids, and these are being analyzed further.

The most important point that is shown in the table is the obvious identity of the order of the genes lac, az, and arab in coli and salmonella. It might be argued that the order is imposed by the sequence in the Hfr. This, however, could not lead to multiple substitutions of genes but only to single substitutions. That these are indeed substitutions and not additions of genetic material is attested to by the facts that selection for lac^c gives frequent linked substitution of either arab⁺ or arab⁻, according to the genotypes of the parents, and that these strains give no evidence of instability.

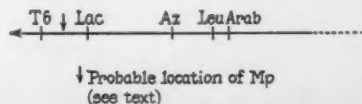


Fig. 1. Genetic map of *E. coli* Hfr (Cavalli).

Table 1. Recombination between *E. coli* and *S. typhimurium*.

<i>E. coli</i> <i>S. typh.</i>	Cross No. 1*				Cross No. 2*			
	lac+ lac-	az ^r az ^r	arab+ arab-	meth- meth+	Lac+ Lac-	az ^r az ^r	arab- arab+	meth- meth+
	Az ^r	arab+	1		Az ^r	arab-	0	
	Az ^r	arab-	112		Az ^r	arab+	27	
	Az ^r	arab+	39		Az ^r	arab-	13	
	Az ^r	arab-	18		Az ^r	arab+	6	

* Selection for meth+ lac+.

The possibility remains that what is selected in the primary cross is a salmonella which has changed the natural order of its genes in such a way as to be colinear with that of the coli Hfr. The low probability of this occurrence could then account for the low frequency of the occurrence recombinants. Further clarification of these points will become available as the genetic map of salmonella is determined independently in salmonella-by-salmonella crosses and salmonella-by-coli crosses.

Transduction between coli genes and salmonella genes. Through the system described above, the appropriate alleles with which to study interspecific transduction were introduced into hybrids. P22 was grown on these hybrids, and the transduction efficiency of a number of alleles in this region was studied. Careful attention was paid to the source of the allele, to whether the phage was or was not modified with respect to the recipient, and to whether the recipient,

in turn, would or would not modify the phage. Let me repeat that phage grown on salmonella (Mp^r) grows equally well on the hybrids but, after growth on the usual hybrid (Mp^c), grows poorly on salmonella. Wherever possible, the attempt has been made to analyze transduction independently of phage-growth characteristics.

Table 2 contains the data which were obtained. They are expressed in terms of the number of transductions per infective phage particle. The minimum frequencies are, of course, determined by the spontaneous mutability of the alleles being studied.

The following points can be developed by analyzing the data in the table.

1) Because of the intrinsic stability of the lac- nature of Salmonella, it may be stated with a very high degree of confidence that the lac+^c is not transduced. However, this very stability may imply that the nature of the change necessary to cause salmonella to ferment lactose is beyond the capacity

of the restricted nature of transduction (8).

2) With regard to the arabinose alleles, where all of the combinations are available, it may be noted that coli genes do not transduce salmonella genes and salmonella genes do not transduce coli genes, or do so only at a frequency of 1/20 that of the normal. However, coli genes do transduce coli genes and salmonella genes transduce salmonella genes.

3) Although leucine requirement was not a marker used directly in the crosses, when the hybrid has an arab coli gene, the transduction of leu^a is restricted. Arabinose fermentation and leucine requirement are closely linked genes and are linked in transduction.

4) With all of the combinations, the marker try[±] was affected in transduction efficiency only when the phage was also restricted in its growth. It lies outside the region under study, and therefore all experiments were try+^a on try-^a.

Conclusions

These two bacteria, *Salmonella typhimurium* and *Escherichia coli*, have been considered, and not without reason, sufficiently different to be worthy of separate generic designation. It is somewhat surprising to find that the gene orders in these species are sufficiently similar to allow for genetic recombination to occur. Thus we find in the same place, in the same order in coli and in salmonella genes affecting the receptors for a bacteriophage (T6), resistance to a drug (sodium azide); fermentation of lactose and arabinose, and synthesis of leucine. In both organisms the genes for galactose fermentation and tryptophan synthesis lie in other areas. Unless some artifact is imposed by the fact that there is a selection of recombinant types, it would seem that the gross features of the salmonella chromosome are the same as those of the coli chromosome. That this is no artifact is indicated by some preliminary evidence from salmonella-by-salmonella crosses, which indicate a similar order of these genes.

However, if, as we suppose, transduction mirrors the finer structure of the genetic material, it is apparent that here sufficient evolutionary diversity has occurred to restrict transduction even for those genes which seem to be common to both organisms. Apparently

Table 2. Transduction of *E. coli* and *S. typhimurium* genes.

Bacterial strain	No. of transductions per infective phage particle				
	Bacteriophage				
	Lac+ ^c arab+ ^c Mp ^c	Arab+ ^c Mp ^a		Lac+ ^c arab+ ^c Mp ^c	Lac+ ^c arab+ ^c Mp ^a
		lac+ ^c	lac- ^c		
Lac- ^a Mp ^a	<10 ⁻¹⁰	<10 ^{-10*}		<10 ⁻¹⁰	<10 ^{-10*}
Arab- ^a Mp ^a	$\frac{4.1^*}{10^8}$	$\frac{6.8^*}{10^8}$	$\frac{5^*}{10^8}$	$\frac{3^*}{10^9}$	$\frac{3^*}{10^9}$
Arab- ^a Mp ^a	$\frac{2}{10^9}$	$\frac{7.2^*}{10^8}$	$\frac{6.4^*}{10^8}$	$\frac{3}{10^9}$	$\frac{2^*}{10^9}$
Arab- ^{a1} Mp ^a	$\frac{2^*}{10^9}$	$\frac{2^*}{10^9}$	$\frac{2^*}{10^9}$	$\frac{4.2^*}{10^8}$	$\frac{5.6^*}{10^8}$
Arab- ^{a2} Mp ^a	$\frac{2^*}{10^9}$	$\frac{2^*}{10^9}$	$\frac{2^*}{10^7}$	$\frac{1.2^*}{10^8}$	$\frac{3.2^*}{10^8}$
Leu- ^a Mp ^a	<10 ⁻⁹	$\frac{3.2^*}{10^7}$	$\frac{1.3^*}{10^7}$	<10 ⁻⁹	<10 ^{-9*}
Gal- ^a Mp ^a	<10 ⁻⁹	$\frac{1^*}{10^7}$		$\frac{5}{10^8}$	
Try- ^a Mp ^a	<10 ⁻⁹	$\frac{9^*}{10^7}$	$\frac{6.8^*}{10^7}$	<10 ⁻⁹	$\frac{5.3^*}{10^7}$

* Bacteriophage grows with an efficiency of about 100 percent.

there have been accumulated many mutations which are relatively innocuous, in the physiological sense, but which cause sufficient diversity of genetic structure to prevent the necessary pairing over short distances prior to recombination. It may therefore be expected that individual differences relative to the "interspecific" transduc-

tion efficiency of different genes may exist, some genes being more efficiently transduced than others.

References

1. L. S. Baron, W. M. Spillman, N. F. Carey, *Science* 130, 566 (1959).
2. T. Miyake and M. Demerec, *Nature* 183, 1586 (1959).
3. L. L. Cavalli, J. Lederberg, E. M. Lederberg, *J. Gen. Microbiol.* 8, 89 (1953).
4. W. Hayes, *Cold Spring Harbor Symposia Quant. Biol.* 18, 75 (1953).
5. J. Lederberg, *Methods in Med. Research* 3, 5 (1950).
6. J. Lederberg, E. M. Lederberg, N. D. Zinder, E. Lively, *Cold Spring Harbor Symposia Quant. Biol.* 16, 413 (1951).
7. N. D. Zinder and J. Lederberg, *J. Bacteriol.* 64, 679 (1952).
8. N. D. Zinder, *J. Cellular Comp. Physiol.* 45, 23 (1955).
9. S. E. Luria, *Cold Spring Harbor Symposia Quant. Biol.* 18, 237 (1953).

Science in the News

United States Satellite Launched into Orbit around Sun

The United States has placed a 94.8-pound satellite, Pioneer V, in orbit around the sun between Earth and Venus (see diagram). The spherical, 26-inch aluminum payload, which was launched by a three-stage rocket on 11 March, will take 311 days to complete a circuit of the sun.

The vehicle carries instruments for five experiments, the most significant device being a 150-watt transmitter designed to permit communications between Earth and the payload at distances of up to 50 million miles. The transmitter is believed to be the most powerful ever flown in deep space—approximately 30 times more powerful than any other United States experimental space transmitter developed to date.

The launching is the third in a series of "paddle-wheel" flights. The National Aeronautics and Space Administration contracted for the series in November 1958 with the Air Force Ballistic Missile Division (Air Research and Development Command). In turn, AFBMD subcontracted with Space Technology Laboratories, Inc., of Los Angeles, for over-all system integration and payload packaging. In all, some 50 subcontractors, including universities and industrial firms, have had a part in the series.

The new satellite, which was propelled at more than 24,869 miles an hour at third-stage burnout, is designed to describe a 506-million-mile path

around the sun at an average speed of about 70,000 miles an hour.

This probe differs from past successful sun-orbiting probes—the Soviet Union's Lunik I (2 January 1959) and the United States' Pioneer IV (3 March 1959)—in that it is inside the earth's orbit. Lunik I and Pioneer IV are in orbits between those of Earth and Mars.

To get it into an orbit between Earth and Venus, Pioneer V was launched in the morning. As the rocket neared escape velocity, it followed the curve and directional spin of the earth. When it escaped, the vehicle was swept into a sun orbit by the sun's gravitational force; it is moving around the sun in the same direction as the rest of the planets.

Significance of the Transmitter

There are several reasons for sending up the powerful transmitter. One objective is to demonstrate the feasibility of long-range space communications. Another involves a new method of measuring astronomical distances.

To date, distances within the universe have been computed from basic laws of physics governing bodies in motion, with positions plotted against seemingly stable distant stars. To astronomers, the basic unit of measurement is the AU or astronomical unit—the mean distance between Earth and Sun, or approximately 93 million miles.

Most scientists agree that this measurement is accurate to only plus or minus 50,000 miles. It is important to future space missions to have more pre-

cise values. Successful long-range communication with this payload should provide a more accurate measure. The transmitter and associated electronic equipment, batteries, and the solar cells for power supply make up more than half the probe's total weight.

Other Instrumentation

A high-energy radiation counter, developed by the University of Chicago, measures high-energy or "hard" radiation, particularly from the sun.

An ionization chamber and a Geiger-Müller tube, together weighing about 2 pounds, are measuring the total radiation flux encountered. They are particularly sensitive to medium-energy radiation. These instruments were supplied by the University of Minnesota.

A 1-pound micrometeorite counter, developed by the Air Force Cambridge Research Center, is measuring the number and momentum of meteoric dust particles striking the probe.

A 1-pound search-coil magnetometer, developed by Space Technology Laboratories, is designed to determine the strength and direction of magnetic fields in space.

An 8-ounce photoelectric cell called an "aspect indicator," also developed by STL, will trigger a specific electrical impulse when it "looks" directly at the sun. These "fixes" on the sun should make the information obtained from the magnetometers and radiation counters more meaningful.

In addition to the instruments listed, Pioneer V contains a number of amplifiers, "logic" units which transform various instrument-sensing actions into transmittable signals, and a command compartment capable of initiating some ten payload functions. Five tiny thermistors are recording temperatures, two on the paddles and three within the payload.

Radio Contact

The probe carries one 5-watt ultra-high-frequency transmitter which, on

command, becomes an amplifier for the 150-watt transmitter. Both transmitters are connected to all instrumentation, but only one transmits at a time. The frequency is 378 megacycles per second.

The satellite is silent (to conserve power) until a transmitter is activated by one of three ground stations. The stations are located at South Point, Hawaii, at Goldstone Lake, Calif., and

at Jodrell Bank in England. The instruments function even when the transmitters are not operating; their findings are stored in electronic accumulators for later transmittal. Radio power is supplied by mercury batteries that are kept charged by solar cells in the four paddles.

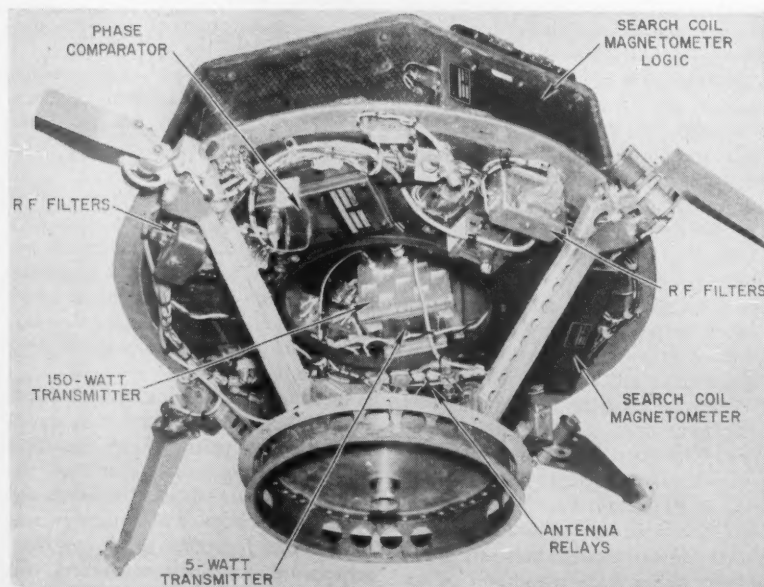
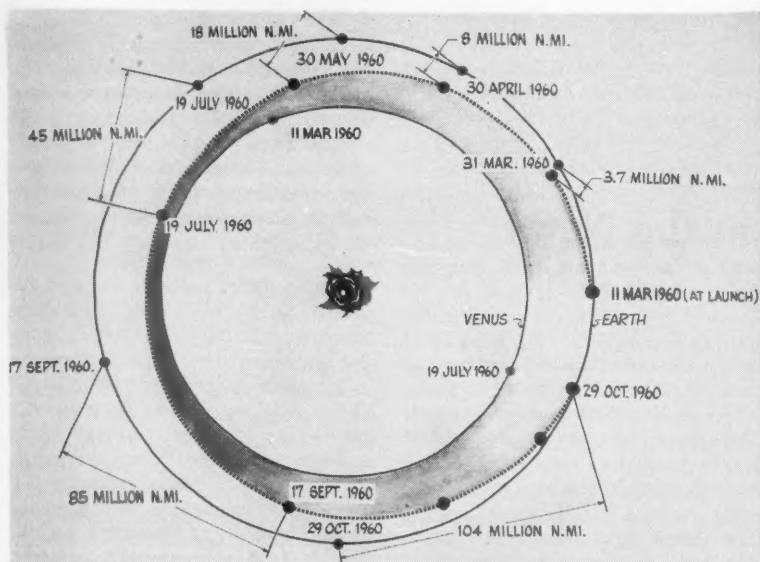
It is expected that periodic radio contact can be maintained with Pioneer V

for at least the next 5 months, until it goes out of range. If the vehicle's instruments hold up under the stresses of space environment, radio contact might be reestablished in 1963, when the satellite is expected to come within 50 million miles of the earth again.

Project Officials

Principal NASA officials involved in this program are Abe Silverstein, director of space flight development, and John Lindsay, head of the solar physics program of the space sciences division.

Key Air Force Ballistic Missile Division and Space Technology Laboratories personnel engaged in the program are Maj. Gen. O. J. Ritland, commander of AFBMD; Ruben F. Mettler, STL executive vice president and senior project advisor; Col. Richard D. Curtin, AFBMD deputy commander for Military Space Systems; George E. Mueller, STL vice president, associate director of the research and development division, and senior project advisor; Lt. Col. Donald R. Latham, AFBMD director of space probe projects; Adolph K. Thiel, STL director of advanced experimental space missions and project director; and Major John E. Richards, AFBMD chief of the astrovehicles division within the space probes directorate.



(Top) Plot of the projected path of Pioneer V in relation to the earth and Venus in the months ahead. (Bottom) View of the 94.8-pound probe payload without its aluminum shell. Near the earth, the 5-watt transmitter will be used for relaying experiment information. But when the probe is several million miles away from the earth, the 5-watt transmitter will become a booster-amplifier for the powerful 150-watt transmitter. [National Aeronautics and Space Administration]

Hearings on Atomic Energy Research Scheduled by Joint Committee

A series of public congressional hearings on "Frontiers in Atomic Energy Research" will be held in Washington 22-25 March, according to Representative Melvin Price, chairman of the Subcommittee on Research and Development of the Joint Committee on Atomic Energy. The hearings will begin with consideration of research in the use of nuclear explosives for peaceful purposes (known as the "Plowshare" project) and then proceed to the program for obtaining power by means of controlled thermonuclear reactions.

After this, the subcommittee will hear testimony on advanced developments in nuclear (fission) power-reactor concepts. Adaptation of nuclear power for outer space propulsion (particularly the "Rover" project) and auxiliary power systems for satellites and space ships (SNAP) will then be discussed. The final session will be devoted to a discussion of direct conversion of nuclear energy to electric power and of the role of solar energy.

Among the scientists who will be witnesses are the following: Henry D. Smyth, chairman of the University Research Board, Princeton University; Edward Teller, director of the Lawrence Radiation Laboratory, Livermore, Calif.; Kraft Ehrlicke, Convair, San Diego, Calif.; and W. H. Zinn, vice president, Nuclear Division, Combustion Engineering Company, Windsor, Conn. A complete list of witnesses will be issued when arrangements are completed.

Council for Advancement of Science Writing Established

The establishment of a Council for the Advancement of Science Writing was announced last month by the National Association of Science Writers. The purpose of the new organization is to raise the standards for science writing and stimulate an increase in the quantity of science news that is carried in all media of mass communications—newspapers, television, radio, magazines, and books for the general public. The council plans to foster research and training in science journalism and to sponsor discussions and seminars on science writing throughout the country. The aim is to heighten the public's understanding and appreciation of the scientific enterprise.

Earl Ubell, science editor of the *New York Herald Tribune* and vice president of the National Association of Science Writers, is president of the council; W. Bradford Wiley, president of John Wiley and Sons, is vice president; and Hillier Kriehbaum, chairman of the department of journalism at New York University, is secretary-treasurer.

The idea for an organization such as the Council for the Advancement of Science Writing grew out of a conference held by the National Association of Science Writers in New York several years ago. The NASW authorized its officers and executive committee to proceed with plans to set up the nonprofit corporation. Pending the opening of an office of its own, the CASW may be reached through Kriehbaum.

Leprosy Laboratory Established

In January the School of Hygiene at Johns Hopkins University celebrated the opening of a joint Johns Hopkins-Leonard Wood Memorial Leprosy Research Laboratory located in the depart-

ment of pathobiology. The laboratory succeeds one which has been maintained by the Wood Memorial for the past 13 years at the Harvard Medical School. Financial support of the laboratory will come from the Memorial, aided by a grant from the National Institute of Allergy and Infectious Diseases of the Public Health Service.

John H. Hanks, bacteriologist of the Memorial for the past 20 years, will be the director. New members of the staff are Claude V. Reich, associate bacteriologist, and Byron S. Tepper, associate biochemist, both of the University of Illinois, and Norman E. Morrison, associate biochemist, who is at present on the staff of the University of Otago, New Zealand. All staff members will have university positions and will teach in the School of Hygiene. The Leonard Wood Memorial, which has headquarters in New York, is devoted to research and education in leprosy.

Occupation Question in 1960 Census Should Be Answered with Care

The 1960 population census will begin on 1 April. In every fourth household each person 14 years of age or older will be asked what kind of work he is doing.

In order that the statistics on scientific and engineering manpower may be developed as accurately as possible, the U.S. Census Bureau has asked that scientists be reminded that the question on occupation should be answered completely and precisely. The entry should consist of at least two words in most cases. Some examples of acceptable entries follow: appraisal metallurgical engineer, design electrical engineer, director of chemical laboratory, process chemical engineer, research physicist.

Student Science Journal Launched

Particle, a quarterly by and for science students, is being published in Berkeley, Calif. Articles are accepted in the fields of chemistry, physics, mathematics, biology, and other natural sciences. The journal was established to enable student readers to discover what other students are doing and thinking in their chosen fields of science, and to afford student authors an opportunity to share the products of their original thinking or research.

The new publication, which is privately supported, has nearly 400 regular

subscribers. These include the libraries and science departments of more than 50 schools and colleges throughout the country, supporting subscribers, and a number of corporate subscribers. The editors are Joseph Weinstein, a student at the University of California, and Lloyd Prentice, a student at Castlemont High School, Oakland, Calif. Subscriptions are \$1.20 in the United States and \$1.60 abroad. For information, write to the editorial and publishing offices, 2531 Ridge Rd., Berkeley 9, Calif.

Oklahoma High-School Science Meeting Has Outstanding Speakers

Some 6000 high-school science students will gather in Oklahoma City, Okla., on 1 April to hear leading scientists trace the steps by which life began on earth. Joining seven biologists on the panel of speakers will be a well-known American author, Philip Wylie, who has a broad, layman's interest in biology.

The occasion will be the annual High-School Science Symposium of the Frontiers of Science Foundation of Oklahoma, a nonprofit organization supported by business and industry. The 1960 topic is "Origins of Life." The American Institute of Biological Sciences is cosponsor.

Participating scientists will be Alfred Mirsky of the Rockefeller Institute, Philip Abelson of the Carnegie Institution of Washington, Stanley Miller of Columbia University College of Physicians and Surgeons, Sidney Fox of Florida State University, Barry Commoner of Washington University, H. Bentley Glass of Johns Hopkins University, and Frank Fremont-Smith of the Josiah Macy, Jr. Foundation.

In addition to the day-long program for students, the symposium will include luncheon and banquet meetings for educators and for civic, industrial, and financial leaders of Oklahoma and surrounding states.

Grants, Fellowships, and Awards

High-school teaching. High-school teachers who need to learn more about the nature and methods of research will benefit from the National Science Foundation's second group of grants in the Research Participation for Teacher Training Program. These will provide for an additional 200 teacher-participants at 23 institutions. The first group

of grants in this program was announced 25 January. The two groups provide for a total of 750 participants at 80 institutions, at a total cost of about \$1,244,000. Participating teachers will receive stipends of up to \$75 per week plus allowances for travel and dependents. A list of cooperating institutions may be obtained from the NSF (Washington 25, D.C.).

Medical student research. The Lederle Laboratories Division of the American Cyanamid Co. has announced that it is making available to medical schools throughout the United States and Canada Lederle medical student fellowships for the year 1960. These fellowships, in amounts not exceeding \$600 per year for any one individual, are intended to relieve in part the financial burden of students who desire to devote their summer vacations to research in the preclinical departments.

Applicants must have good scholastic standing and must have the consent of the faculty member under whose supervision their research is to be conducted. The selection of students to receive such awards will be made by the dean of the medical school, or by the regularly constituted committee of the faculty charged with such selections. By special permission of the dean or the fellowship committee of the school, the student may carry on such research in another medical school, provided that satisfactory arrangements are previously made with the faculty member of the school and the department in which the student is to carry on his research.

Physiological psychology. St. John's College, Cambridge, England, is seeking candidates for this year's Kenneth Craik research award, which is for the assistance of postgraduate research, preferably in physiological psychology. Persons of either sex and of any academic standing are eligible. The award recipient need not be, and is not required to become, a member of the college and need not reside in the University of Cambridge, but must submit such reports on the place, nature, and progress of his or her research as the college council may require.

The value of the award will be £450 a year. The council may pay part of the award in the form of a grant or grants to meet specified costs incurred in connection with the research undertaken; such costs may include the costs of travel, of pur-

chasing or hiring apparatus or other equipment, or of obtaining technical or clerical assistance.

The award will be tenable from 1 October 1960 for a period of not less than 1 year or more than 3 years, as the council shall decide. If the period decided upon is less than 3 years, the tenure may be subsequently extended, but the award may not be held by the same person for more than 3 years in all.

Applications should be sent to The Master, St. John's College, Cambridge, to reach him *not later than 4 April*. They should be accompanied by full particulars about the applicant; by a statement of the nature and probable duration of the postgraduate research contemplated and of the place where he or she intends to pursue it; by particulars about any further financial assistance the applicant expects to receive; and by the names and addresses of not more than three persons to whom the council may refer. No testimonials should be sent.

News Briefs

Chinese nuclear test? It is rumored that a small atomic bomb of "Hiroshima size" will be exploded on the Chinese mainland. A member of the Indian parliament is reported to have said that a "whole chain of people" in Communist China have told him about the nuclear test, which may be scheduled to take place on 28 March near Urumchi, capital of Sinkiang province. The 10 March *Manchester Guardian Weekly* says that Emelyanov, chairman of the Soviet Atomic Energy Administration, has dismissed the rumor as a "fairy tale."

Tribute. The National Association of Science Writers has made a gift of \$100 to the National Multiple Sclerosis Society in memory of Dorothy Negus, wife of Sidney S. Negus, an honorary member of the association and AAAS director of public information. Negus is professor of biochemistry at the Medical College of Virginia in Richmond.

Westinghouse talent search. Jerome G. Spitzner of St. James, Minn., has been chosen from a field of 29,000 high-school seniors from every state in the union as winner of the \$7500 Westinghouse Science Scholarship—top award in the 19th annual Science

Talent Search. He designed and built a spherical ion accelerator for his talent search project. His scholarship was one of five scholarships and 35 cash awards recently presented in Washington to the 9 girls and 31 boys who were this year's winners. Other scholarship recipients were Melvin Hochster, Brooklyn, N.Y., \$6000; Frank Podosek, Ludlow, Mass., \$5000; Charles H. Bennett, Croton-on-Hudson, N.Y., \$4000; and Betty Lou Snarr of Oklahoma City, Okla., \$3000.

Non-Communist affidavit. Two more colleges have withdrawn from the student-loan program of the National Defense Education Act because it requires a "non-Communist" affidavit. These are the interdenominational Theological Center in Georgia and Wesleyan University in Connecticut. The total number of withdrawals so far is 15 colleges. One more institution, Beloit College in Wisconsin, has declined to take part in the program rather than fulfill the affidavit requirement; this brings to eight the number of institutions that have refused to participate. Forty-eight other institutions have objected to the affidavit while remaining in the program, raising the over-all total of college protests to 71. Bills for the repeal of the affidavit requirement are pending in both houses of Congress.

World health day. World health day, 7 April, is the anniversary of the day on which the World Health Organization came into being. The organization, which has a membership of 90 countries, was established in 1948. It is one of the specialized agencies of the United Nations. The theme of World Health Day 1960 is "Malaria Eradication—A World Challenge." Under WHO leadership, the countries of the world are engaged in a united effort to wipe out this disease. This is the first such world-wide eradication campaign.

Scientists in the News

The 1959 Viking Fund Medalists in anthropology were awarded prizes of \$1000 each at the 14th annual banquet of the Wenner-Gren Foundation for Anthropological Research. The recipients were as follows.

William W. Greulich, chairman of the department of anatomy at Stanford University, selected by the American Association of Physical Anthropology.

Irving Rouse, professor and head of

the department of anthropology at Yale University, selected by the Society for American Archaeology.

Leslie A. White, professor of anthropology at the University of Michigan, selected by the American Anthropological Association.

Clark T. Randt, scientist for space medical research for the National Aeronautics and Space Administration, has been appointed director of NASA's new Office of Life Sciences.

Charles R. Mallory, medical officer in charge of the Public Health Service Indian Health Area, Albuquerque, N.M., has been named assistant surgeon general and appointed deputy chief of the Public Health Service's Bureau of Medical Services. He succeeds **Arnold B. Kurlander**, who has been assigned to the Surgeon General's office.

Watson Davis, director of Science Service, will receive the James T. Grady Medal for reporting in the field of chemistry, at the 137th meeting of the American Chemical Society.

Alan J. Hodge, research associate in biology at Massachusetts Institute of Technology, has been appointed to a professorship at the California Institute of Technology, where he will develop a new laboratory of electron microscopy.

J. Calvin Brantley, assistant director of research for Union Carbide Nuclear Co., a division of the Union Carbide Corp., has been appointed director of research for the division.

S. G. Soal and **H. T. Bowden** have been awarded the fourth William McDougall Award for their book *The Mind Readers*. The staff of the parapsychology laboratory at Duke University chose this work as the most representative research study in the field, published during 1959. Soal retired in 1954 as senior lecturer in pure mathematics at Queen Mary College, University of London; Bowden is a member of the Council of the Society for Psychological Research in Great Britain.

John R. Bowman, associate dean of engineering and professor of engineering sciences at Northwestern University, is on academic leave at the University of Alaska.

John M. Richardson, chief of the gaseous physics group at the Boulder Laboratories of the National Bureau of Standards, received the Boulder Scientist Award for 1959 at a meeting of the Boulder branch of the Scientific Research Society of America. Richardson was cited for his paper on the evaluation of oxygen microwave absorption as a possible atomic frequency standard.

Verner J. Wulff, professor of zoology and chairman of the department at Syracuse University, has accepted a research position at the Masonic Research Laboratory in Utica, N.Y. **Fredrick G. Sherman**, professor of biology at Brown University, succeeds him at Syracuse.

James M. Gavin, executive vice president of Arthur D. Little, Inc., has been elected president of the company. He succeeds **Raymond Stevens**, who has been named chairman of the executive committee. Gavin retired from the Army in 1958 after serving as chief of Army Research and Development.

Stevenson Buchan, chief geologist of the water division of the Geological Survey and Museum, London, England, will be in the United States until April. His itinerary includes New York, Washington, Urbana (Ill.), Bloomington (Ind.), Lexington (Ky.), and Iowa City (Iowa).

Barnett F. Dodge, professor and chairman of the department of chemical engineering at Yale University, will discuss fresh water from the ocean and other saline waters, from 28 March through 30 April, at a number of colleges and universities, as a Sigma Xi national lecturer.

The Case Institute of Technology, Cleveland, Ohio, has announced the appointment of the following scientists.

Carl Schalen, professor of astronomy at the state university at Lund, Sweden, as visiting professor of astronomy.

Herbert Shepard, adjunct associate professor of psychology at New York University, as professor of behavioral science in the department of management.

R. M. Thaler, staff member of the Los Alamos Laboratory, as associate professor of physics.

Richard S. Varga, numerical analyst with the Westinghouse Electric Corp., as professor of mathematics.

Recent Deaths

Aleksandar Belic, Belgrade, Yugoslavia; 84; chairman of the Serbian Academy of Science since 1937; creator of modern Serbo-Croat orthography; 26 Feb.

Joseph E. Fleury, Rangoon, Burma; 69; paper technology specialist for the Armour Research Foundation of Illinois Institute of Technology; staff member of the Union of Burma Applied Research Institute; 6 Feb.

Walter C. Hausheer, New Brighton, N.Y.; 65; researcher in tropical medicine with the Rockefeller Foundation from 1919 to 1928; associate medical director of the Prudential Insurance Co. until 1959; 25 Feb.

Ezra J. Kraus, Corvallis, Ore.; 74; visiting professor in horticulture at Oregon State University; chairman of the department of botany at the University of Chicago from 1934 to 1949; developer of the weed killer dichlorophenoxyacetic acid and of many new varieties of chrysanthemum; 28 Feb.

Alden E. Noble, Stockton, Calif.; 61; marine biologist and parasitologist; professor and chairman of the department of zoology at the College of the Pacific; former director of the Pacific Marine Station; 19 Feb.

Edward L. Rice, Urbana, Ill.; 88; professor emeritus of zoology at Ohio Wesleyan University; author of *An Introduction to Biology*; 4 Feb.

Tom D. Spies, New York, N.Y.; 57; professor of nutrition and metabolism and chairman of the department at the Medical School of Northwestern University; pioneer in pellagra research; author of books and articles on clinical nutrition; 28 Feb.

William A. Whitaker, New York, N.Y.; 76; inventor of a process for the flotation of oxidized ores; formerly professor of chemistry and metallurgy at the University of Kansas; 28 Feb.

George Winchester, New Brunswick, N.J.; 85; professor emeritus of physics at Rutgers University; specialist in photoelectricity, surface tension, low temperatures, and solar radiation; 14 Feb.

Erratum: The second sentence of the third paragraph of the report by A. N. Epstein, "Water intake without the act of drinking" [*Science* 131, 497 (19 Feb. 1960)], should have read "With this in mind, a chronic gastric tube for rats was developed that is passed through the nasopharynx, thus bypassing the head and oropharyngeal receptors." In the published report, a corrected version of a line from the following sentence, "nasopharyngeal gastric tubes were first," was substituted for the words "nasopharynx, thus bypassing the head. . . ."

Book Reviews

The Afro-Asian States and Their Problems. K. M. Panikkar. Day, New York, 1959. 104 pp. \$3.

The problems of economically underdeveloped societies in Asia, Africa, Latin America, and elsewhere have been receiving increasingly close attention from contemporary social scientists. The present condition of these lands, whose population comprises the larger part of mankind, is marked by the universal spread among their submerged masses of growing expectations of a better life, and their future is beset by too many unpredictable variables. Many of these societies have been, and a good many still are, within the shrinking area of colonial holdings in Asia and Africa. As they emerge from colonial tutelage and join the swelling ranks of new states, they add a new dimension to the changing scene of international politics and organizations. Whatever their ideology or traditional culture, they are engaged in building newly sovereign political institutions and, simultaneously, in speeding-up their economic growth in accordance with mounting pressures from below.

Most of the current research on these societies is undertaken by Western economists, political scientists, sociologists, and cultural anthropologists in terms of their special concerns and methodology, with much of it confined to the exploration of particular countries or regions. The present study, for all of its brevity, has a threefold interest: the author, in lecturing before the Institut d'Etude de Developpement Economique et Social at the Sorbonne (Paris), seeks to provide a synthesis of the problems these new states have in common; he views the problems as an experienced man of affairs (now a diplomat, formerly an administrator) rather than as an academic specialist; and his viewpoint is not that of a Western outsider, but that of an Indian

who is deeply involved in the efforts of one of these new nations, whose economic and political growth profoundly affects the delicate balance of Asia and the rest of the world. Firm convictions and a flair for the broad view, which Panikkar has demonstrated in former books (*Asia and Western Dominance*, *In Two Chinas*, and *India and the Indian Ocean*), have aided him in the study under review.

There are certain factors that Panikkar regards as having revolutionary significance for the 20th-century environment into which these new states have been cast: the political communities, unlike their 19th-century precursors, have become "coextensive with the totality of adult populations including women"; the new industrial revolution has caused unprecedented dependence on continuous scientific and technological support, along with vastly enlarged human and financial requirements; and this stimulates, especially in Asia, social changes so vast "as to make the period before the second World War look like a forgotten ancient regime." How Panikkar develops his theme in his concentrated discussion of the principal problems arising in the political, administrative, economic, educational, scientific, and social spheres cannot be summarized here. It would be difficult to find a comparable survey that, in nontechnical terms, succeeds in illuminating the whole complex of interrelated issues. Among the political questions to which Panikkar directs attention are the problems of responsible participation and consent which arise with the widespread adoption of republican, representative, and usually parliamentary institutions. "Generally accepted codes of political behavior," free-functioning and organized oppositions, truly independent thought, and respect for basic rights are not ordinarily part of the colonial heritage, nor is the natural submission of the execu-

tive to the control of an elected assembly. Panikkar does not hesitate to speak of democracy in most of the states as "a borrowed ideology, whose implications are little understood . . . text book democracies with but little relation . . . to the social and economic conditions of the countries concerned." Considering the scarcity of trained indigenous officials, administrative services suffer from the withdrawal of the colonial powers' top civil servants at the very moment when the demands of social and economic development everywhere call for expansion.

In his discussion of the economic problems, Panikkar touches on the standard phenomena of shortages in investment and relevant skills and draws attention to the perils besetting foreign financial assistance where there are no "regular or fruitful channels of expenditure." In such situations, he warns, such assistance may heighten social tensions and become a source of corruption. Here, too, he dwells on the key role of technical skills and scientific knowledge, an area in which India enjoys special advantages, compared with most other countries of the Afro-Asian region. All of this lends special importance to the advancement of education, a field in which, he believes, international assistance can make only a limited contribution. Western readers will appreciate his forthright appraisal of the missionary's contribution to education in a new nationalist environment.

In commenting on the vital place of science in the new states, he strikingly brings out the existence of a vicious circle: just as the lack of industrial background has failed to stimulate interest in scientific development, so has the scarcity of scientific and technological manpower, in turn, inhibited industrial growth. He sees the gap between scientifically advanced and scientifically retarded countries inevitably widening, and with this the specter of the old dependence in a new form.

There is bluntness and realism in Panikkar's examination of the newly independent Afro-Asian world. While disclaiming pessimism, he offers a list of formidable problems and endemic difficulties that will constitute a challenge to Afro-Asian and to Western leadership for a long time to come.

WOLFGANG H. KRAUS
*School of Government,
George Washington University*

Taxonomy of Flowering Plants. C. L. Porter. Freeman, San Francisco, 1959. xii + 452 pp. Illus. \$6.75.

This handsomely illustrated volume is expressly designed to help fill the gap "between texts that are really reference books for advanced students and much abbreviated texts that have had much of the meat of the subject deleted from them." Porter's work is not intended to win new beachheads in the advancement of plant classification. The average student of applied botany might use the book for his first (and probably only) taxonomic course without discovering that there is more to the subject than identification by morphological characters. For those who are interested, however, the quietly planted leads and excellent, selective bibliographies should enable them to penetrate as far as enthusiasm carries.

The book is divided into three sections: the first deals succinctly with the history, methodology, and traditional theory of the subject, the second with some 19 orders and 23 families of monocotyledons, and the third with 35 orders and 80 families of dicotyledons. The author is tacitly neutral on questions of phylogeny. Selection of groups is clearly intended for a North American audience, and the well-illustrated description of families is stressed. If some choices of arrangement, of taxonomic concept, and of nomenclature are open to debate, these matters will not trouble the students to whom the book is addressed.

I find the volume refreshingly clear, straight-forward, unassuming, and unpretentious. The author has succeeded most admirably in attaining his worthy, if limited, objective.

LINCOLN CONSTANCE

Department of Botany,
University of California, Berkeley

Russian Diary. Gaylord P. Harnwell. University of Pennsylvania Press, Philadelphia, 1959. 125 pp. Plates. \$3.75.

Russian Diary is just that—an entertaining and instructive account of a busman's holiday. Gaylord Harnwell was a member of one of the cultural exchange groups (this group was made up of college and university presidents) going to the Soviet Union to obtain

firsthand knowledge about higher education there. The diary covers about 2 weeks during the summer of 1958 and about 5000 miles of travel within the Soviet Union.

The diary is simply written, and its general flavor of good humor conveys the author's pleasure in the experience. The diary is human in that it reflects a good observer's frank curiosity toward life behind the Iron Curtain. Harnwell found much to interest him besides the organization and structure of higher education and scientific research in the U.S.S.R.: the arts, the culture, and the day-to-day living experiences available to the visiting group in their busy schedule of travel that ranged from Leningrad and Moscow to Tashkent, Samarkand, and Alma-Ata. One particularly interesting feature of the book is its frequent mention of the food and drink enjoyed by the group under various circumstances, suggesting that the busman's holiday had its compensations and anticipating the inevitable questions on the care and feeding of the inner man in terra incognita.

In condensed form, Harnwell gives the basic concepts and operations of higher education in the U.S.S.R. His own background in science, research direction, and university administration led to his particular focus of interest and to his selection of material from the vast Soviet educational effort that has been and is being studied by our specialists from various fields. Harnwell noted particularly the relation of the Soviet Academy of Sciences to the educational institutions and to the laboratories that it operates, as well as the breadth of knowledge that it includes. Indeed, the Russian word translated freely as "science" is far broader in its meaning than the English word, and the Soviet Academy in its composition and operations reflects this broader concept of higher learning.

The diary includes a short section dealing with advanced degrees—Kandidat and Doctor, but does not make clear that both degrees are under the central control of the Higher Attestation Commission. This centralized authority for granting higher degrees is a feature of unusual interest to educators in the United States.

Another unusual feature of Soviet higher education is that engineering is taught in separate institutes, not in the universities. Although the diary de-

scribes the Leningrad Polytechnic Institute, an outstanding engineering school, attention is not directed to the novel relationship between the engineering schools and the universities.

Harnwell's *Russian Diary* has the merits of brevity, substance, and entertainment, and it provides a pleasant as well as a rewarding evening's reading. The photographs add substantial interest. Those particular readers who have been to the U.S.S.R. will relive in the diary many common experiences.

FREDERICK C. LINDVALL

California Institute of Technology,
Pasadena

Prologue to Teaching. Reading and source material. Marjorie B. Smiley and John S. Diekhoff, Eds. Oxford University Press, New York, 1959. xvii + 590 pp. \$5.75.

This is a text prepared for use in professional education courses at the undergraduate level. Because it is so different from traditional texts for these courses, and because the prospective teacher who studies these materials will be exposed to the writing of scholars and by this exposure, soundly introduced to a philosophical approach to modern education, the book seems worthy of review in *Science*. In a real sense this text material represents the substantial discipline which professional education could become.

The book consists of selections from writings about education by scholars from the time of Plato and Aristotle to Commager and Riesman. Included are selections by major educators such as Pestalozzi and John Dewey, and documentary materials from Supreme Court decisions, editorials, and prominent educational committees. The text is wholly exploratory. Competing viewpoints are presented so that the student may formulate from them his own philosophy of education. The editor's essays introducing each section should contribute to the understanding of the implications and the significance of the various quotations.

The authors and publishers indicate that the book could be used for a variety of purposes in education. The fact that this is true is perhaps one basis for criticism of current professional education courses. I suggest that this prologue, along with work in the psychology of

learning and human development and student teaching, could possibly become the basic course for teachers.

All those interested in the modern education scene will find much pleasure in reading these excerpts and the editors' stimulating interpretations of them. As academicians become more involved in planning teacher education programs, this material can be a source of substantial information on the educational thought of all the ages.

JOHN R. MAYOR

*American Association for the
Advancement of Science*

Relativity for the Layman. James A. Coleman. Macmillan, New York, N.Y. (reissue), 1959. x + 127 pp. \$3.50

The ABC of Relativity. Bertrand Russell (revised edition, edited by Felix Pirani). Allen and Unwin, London; Essential Books, Fair Lawn, N.J., 1959. 139 pp. \$3.50.

Both these books are intended to explain relativity to the layman. Both authors are competent to do so, and both books have sufficient merit and acceptability that one represents a revised version and the other a reissue. But there the similarity ends. Whereas James Coleman is an experienced teacher of physics at a university catering principally to undergraduates, Bertrand Russell is a veteran philosopher and mathematical logician, who addresses the highly educated and sophisticated layman.

Coleman devotes about three-quarters of his book to the special theory of relativity; in the remainder he discusses the general theory of relativity, cosmological implications, and unified field theory. For a first introduction, intended for persons not specializing in physics, this appears an altogether reasonable balance. The presentation is on the whole careful, although it is remarkable that, in his discussion of Lorentz transformations, Coleman avoids completely any discussion of simultaneous events. The explanation concerning the relative character of simultaneity, which is offered later on and which is based on the time of transit of light signals, is misleading, if not downright incorrect. Likewise the explanation of the twin "paradox" leaves much to be desired.

Probably the root of the difficulty in his handling of the twin paradox is an erroneous belief, shared by Coleman with many others, that the special theory of relativity deals only with objects in uniform motion or at rest, whereas the general theory of relativity deals with accelerated objects and systems. The fact of the matter is, of course, that the special theory deals with accelerated objects and is capable of using even accelerated (coordinate) systems, but only the general theory of relativity treats successfully the gravitational field and accelerations caused by gravitational forces. Accordingly, the twin paradox was stated and explained definitively by Einstein in his first paper on the special theory, dated 1905, long before he even came to grips with the problem of gravitation.

Though these are relatively serious criticisms, the readers for whom Coleman writes—the not-too-serious, non-science majors in an undergraduate school—will probably not be led too far astray by these lapses, and they will profit from the author's style, which conveys some of the drama of scientific discovery without becoming pompous. The illustrations are whimsical, some of them instructive, and they will maintain the reader's interest in the proceedings.

Russell writes for an entirely different public. The first edition of the *ABC* appeared in 1925, when any nonscientist would read a book on relativity only because of intellectual curiosity, not because science might be good for something. Accordingly, Russell makes demands on his readers' intellectual cooperation, and he hardly bothers with "sweetening the pill." This is a serious book, which includes a discussion of the epistemological aspects of relativity, as well as of its relationship to quantum theory and to the remainder of physics and the natural sciences. Less than half of this book is devoted to the special theory, and several chapters are allotted to the philosophical and semiphilosophical issues. There is one passage of dubious validity that I noticed: It is claimed that the steady-state model is consistent with the conservation of energy, an assertion that is, at best, speculative. Otherwise the book is written elegantly, with Russell's usual felicity of formulation. For the truly intelligent layman, Russell's exposition, along with Einstein's own (*Relativity, the Special and the*

General Theory, 1917) and that by Einstein and Infeld (*The Evolution of Physics*, 1938) remain my favorites. The revisions by Pirani have brought the book up to date, without destroying the continuity of contents and style.

PETER G. BERGMANN

*Department of Physics,
Syracuse University*

Scoring Human Motives: A Manual.

John Dollard and Frank Auld, Jr. Yale University Press, New Haven, Conn., 1959. 452 pp. \$9.50.

Anyone interested in the analysis of verbal productions, such as those used in psychotherapy, will find this book indispensable. Based on extensive research, it gives instructions for delimiting each unit and for ascribing conscious or unconscious motivations such as anxiety or hostility. Two chapters of evidence are presented in support of validity and reliability.

The main content of the manual comprises the coding categories, their definitions, and some extensive illustrations and practice exercises. There are 77 categories of classifications of the patient's productions; 15 of these are major categories, the others are permutations. There are only four important therapist's categories; this small number is probably the main weakness of the manual. Perhaps this may reflect restrictive aspects of the authors' therapy. However, the authors indicate, possibly as self-justification, that other investigators have devised numerous methods for analyzing the verbal activity of therapists, and that it is the client material which has not previously been well handled.

Hours of careful hypothesizing and validating are reported. Dollard and Auld have produced what is undoubtedly one of the best available classification schemes for analyzing client productions in psychotherapy. Whether the scheme can be used in nontherapeutic interviews is not easily determined, since the motives occurring in other types of interviews may constitute different patterns; it seems probable, however, that the method has fairly widespread applicability. Although the authors have reviewed the contributions of other investigators, an apparent oversight is the lack of reference to the classification scheme for motives devised by Henry

Murray in the 1930's; the present classifications are strikingly parallel. Dollard and Auld know Murray's system, and it is hard to believe that enmity between Yale and Harvard could have produced unconscious repression. Rather, it is apparent that Murray's fundamental work on the analysis of projections can now be taken for granted.

In a long appendix, James Dittes contributes a scholarly, evaluative survey of previous studies bearing on content analysis in psychotherapy.

WILLIAM U. SNYDER
Department of Psychology,
Pennsylvania State University

Handbook of Circulation. Analysis and compilation by Philip L. Altman. Dorothy S. Dittmer and Rudolph M. Grebe, Eds. Saunders, Philadelphia, Pa., 1959. xv + 393 pp. Paper, \$7.50.

This volume, prepared under the direction of the Committee on the Handbook of Biological Data (National Academy of Sciences-National Research Council), is the tenth in that committee's *Handbook* series and is a companion volume to the *Handbook of Respiration* (1958). Its purpose is to provide a one-volume, comprehensive compilation of data on circulation; the volume lists 325 contributors and reviewers.

Class in American Society. Leonard Reissman. Free Press, Glencoe, Ill., 1959. xii + 436 pp. \$6.75.

Presumably this work is intended primarily as a text for sociology courses, but since the professional jargon is kept to a minimum and the footnotes are grouped inconveniently at the back, a general reader interested in the subject might be tempted to buy it. I do not advise him to do so. Two other recent books with approximately the same title, one by Bernard Barber and one by Joseph Kahl, are more competent, more original, more interesting.

In the very first sentence, we are informed that this work is about "the place of class and its synonyms, status, prestige, and power, in the structure of American society." As Reissman assures us, he has made "no attempt . . .

to insist too obviously upon neat distinctions" among these several terms. This lack of conceptual order, combined with his facile eclecticism, means that every element of the book is the consequence merely of the author's caprice, for it is obviously impossible to include as much as the absence of discrimination promises. Why a discussion of Marx and not of Lenin, Bernstein, Milosz? Why Schumpeter and not T. H. Marshall? Why an analysis of elites with no mention of Pareto and Mosca? And among those who made significant contributions specifically to the study of "class in American society," why pass over Kinsey, Liston Pope, Patricia West, Philip Selznick, Paul Lazarsfeld, Bernard Berelson, and so on? Nor is the book better for concentrating on only a portion of its supposed subject. The study of social classes is ordinarily polemical; Reissman manages, with an adeptness worthy of a better object, to express the bias of his favorite sources while emasculating their frequently virile styles. "Objectivity," as too often in the social sciences, is merely symbolized by flabby prose. The "dominant theme" of the book, announced in the second sentence, is that "classes do exist even though individuals are not chained to these social positions with unequivocal finality"; and the routine perspective suggested in this opening sets the tone for the entire work.

While there are few errors of fact, many interpretations are subject to serious challenge. Is it true, for instance, that Marx began with "the forms and character of classes as they were found to exist" and then "went on from there to a more general analysis"? In his historical studies Marx invariably found it necessary to recognize five or six social classes, and the two-class theory that bears his name derived from his political philosophy and ultimately from the Hegelian dialectic. Is it reasonable, as another example, to measure the educational "opportunities" available to the various social classes by the proportions that actually attend school? Is it consistent to denote professional occupations as "the most closed" to persons born in other classes when the proportion of professionals has increased by almost three times since 1870; or to denote the unskilled as relatively immobile when the proportion so characterized fell off over the same period from 44 to 19 percent of the labor force?

More fundamentally, I seriously doubt whether one can appreciate the complexities of America's social structure without a detailed cross-cultural comparison. As Reissman demonstrates, it is far too easy without such a check to belittle the relatively impressive record of social mobility, to denounce the "prophets of conformity" who express the culture's self-consistency—in general, to analyze every feature of this society as specific to it.

WILLIAM PETERSEN
Department of Sociology,
University of California, Berkeley

New Books

Advances in Clinical Chemistry, vol. 2. Harry Sobotka and C. P. Stewart, Eds. Academic Press, New York, 1959. 400 pp. \$12.

Atlas of Bacterial Flagellation. Einar Leifson. Academic Press, New York, 1960. 177 pp. \$7.50.

Cates' Primary Anatomy. J. V. Basmajian. Williams and Wilkins, Baltimore, ed. 4, 1960. 371 pp. \$6.50.

Chemical Micromethods in Clinical Medicine. R. H. Wilkinson. Thomas, Springfield, Ill., 1960. 121 pp. \$5.

Chromatographie. En chimie organique et biologique. vol. 1, *Généralités.* Applications en chimie organique. E. Lederer. Masson, Paris, 1959. 682 pp. Paper, F. 9000; cloth, F. 10,000.

Classical Mathematics. A concise history of the classical era in mathematics. Joseph Ehrenfried Hofmann. Philosophical Library, New York, 1959. 159 pp. \$4.75.

Consequences of Disturbance. Alan Mozley. Lewis, London, 1960. 71 pp. 9s.

Cybernetics and Management. Stafford Beer. Wiley, New York, 1959. 232 pp. \$4.50.

Directory of Nuclear Reactors. vol. 2. Research, test and experimental reactors. International Atomic Energy Agency, Vienna, Austria, 1959 (order from International Publications, New York 22). 348 pp. Paper, \$3.50.

Elements of Cartography. Arthur H. Robinson. Wiley, New York, ed. 2, 1960. 351 pp. \$8.75.

Enzymes. Uitgevers, Zwolle, Netherlands, 1959. 158 pp. F. 9. The seven lectures published in this volume were given at the International Conference on Enzymes and Their Action held in Wageningen on 6-9 April 1959.

Figures of Equilibrium of Celestial Bodies. With emphasis on problems of motion of artificial satellites. Zadnek Kopal. Univ. of Wisconsin Press, Madison, 1960. 141 pp. \$3.

Fundamentals of Electronics. E. Norman Lurch. Wiley, New York; Chapman and Hall, London, 1960. 645 pp. \$8.25.

Subsurface Mapping. Margaret S. Bishop. Wiley, New York, 1960. 207 pp. \$5.75.

The Thunder of the Guns. A century of battleships. Donald Macintyre. Norton, New York, 1960. 352 pp. \$3.95.

Reports

Gold-198 Wires Used To Study Movements of Small Mammals

Abstract. Eastern harvest mice, *Reithrodontomys humulis humulis* (Audubon and Bachman), were tagged with subcutaneously inserted 20 gauge gold-198 wires 10 mm long and varying in activity from 0.7 to 4.5 mc. None of the tags inserted by this method were lost or had any apparent effect on the animals. The movements of the tagged mice were successfully traced with a portable Geiger counter.

The use of radioactive tags as tools to trace the movements of small mammals is a comparatively new technique (1). Before the use of isotopes, investigators relied upon live-trapping as the chief means of determining the home range of a small mammal. The most apparent limitation of the live-trapping technique is obvious, for an animal must be trapped at least ten times to obtain a representative estimate of its home range (2). The isotope tagging method can provide considerably more information about the individual animal than live-trapping. It also permits studies to be conducted at night and in all types of weather, it eliminates multiple handling and trapping, and it does not restrict spatial movements (3).

Cobalt-60 and phosphorus-32 are the only isotopes previously utilized in studies of small mammals (1). Selection of Au¹⁹⁸ was made because gold possesses a short half-life of 2.7 days as well as an adequate gamma energy of 0.41 Mev. Because a tag may be lost, a short half-life is a decided safety factor (4). Gold-

198 provides this safety factor but does not detract from the useful life of the tag.

The lowest activity of tags used in this investigation was 0.7 mc, which allowed detection of the mouse at a maximum distance of 9 feet with a portable Geiger counter (RCA model WF-12A). Each of the harvest mice tagged with a 0.7 mc source was detectable for 1 week. By the seventh day the decrease in detection distance to about 1½ feet necessitated capture of the mice in order to retrieve the gold wires. One mouse was tagged with a 3.9 mc source and was easily followed for 10 days before radioactive decay of the tag made it necessary to recapture the mouse. The highest activity of a single tag was 4.5 mc, which permitted initial detections up to 20 feet. However, during the first two days this tag proved to be less desirable than tags of lesser activity because the high level of radioactivity exceeded the capacity of the Geiger counter, which made it difficult to establish the precise locations of the mouse. In this instance the animal was allowed to remain free for 10 days before recapture.

To be tagged, a mouse was transported a short distance from a study plot to the laboratory, where it was anesthetized with ether and placed ventral side up on an operating board. A wire bit under the upper incisor teeth and a rubber band over the hind legs immobilized the animal. A 16-gauge hypodermic needle was inserted subcutaneously in the lower abdominal region. With a pair of 5-inch forceps, a 10-mm piece of 20-gauge Au¹⁹⁸ wire was extracted from a lead container and placed in the exposed orifice of the needle. Next, a 5-inch piece of 20-gauge steel wire was used to push the gold wire through the hypodermic needle and implant it under the skin of the mouse. Both the steel wire and hypodermic needle were then removed, leaving only a tiny puncture in the skin. The mouse was placed in a small cage to recover before it was returned to the study plot and released at the point of

capture. The entire procedure, from removal of the trap from the field to release of the mouse, required less than 1 hour.

Labeling operations were performed from behind a lead shield which protected all parts of my body except arms, head, and neck. The use of the lead shield may be superfluous, for the activity of Au¹⁹⁸ is low and the exposure time was only a minute or two. At no time during the investigation was my film badge dose meter overexposed.

For field use, the detection tube of the Geiger counter was extended 24 inches in front of the instrument by affixing the tube to the distal end of a stick which was attached, at the other end, to the counter itself. This arrangement permitted a wider radius of detection than did holding the tube in one hand and the counter in the other. Head phones proved to be extremely helpful, since any increase over background radiation was first audible before it became apparent on the meter. Night work, moreover, made the use of headphones essential.

To facilitate location of a tagged mouse, transverse cords were extended at 10-foot intervals across a rectangular-shaped study plot. The aisles thus formed were used to conduct a systematic search for a tagged mouse. The usual procedure was to sweep the Geiger counter from left to right as the investigator, by trial and error movements, attempted to locate the source of radiation. Care was exercised when approaching the mouse to avoid alarming it. Usually, while it remained hidden under the thick grass or in a nest, the mouse could be approached to within 4 feet. When this proximity was possible, the Geiger tube could be extended to within a few inches of the hidden mouse. Each location was marked for reference with an inscribed paper tag attached to the end of a piece of coat-hanger wire. During the course of the study, 180 locations of tagged mice were made by this procedure. Only on a few occasions did the hidden mouse seem to be disturbed by the presence of a person (5).

STEPHEN V. KAYE*

Department of Zoology,
North Carolina State College, Raleigh

References and Notes

1. G. K. Godfrey, *J. Mammol.* **34**, 503 (1953); *Ecology* **35**, 5 (1954); *ibid.* **36**, 678 (1955); L. S. Miller, *ibid.* **38**, 132 (1957).
2. W. F. Blair, *Contrib. Lab. Vertebrate Biol., Univ. Mich., Publ. No. 48* (1951).
3. R. C. Pendleton, *Ecology* **37**, 686 (1956).
4. D. R. Griffin, *ibid.* **33**, 329 (1952).
5. This investigation was supported by a grant from the North Carolina Academy of Science.

* Present address: Ecological Research Section, Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.

9 October 1959

Instructions for preparing reports. Begin the report with an abstract of from 45 to 55 words. The abstract should not repeat phrases employed in the title. It should work with the title to give the reader a summary of the results presented in the report proper.

Type manuscripts double-spaced and submit one ribbon copy and one carbon copy.

Limit the report proper to the equivalent of 1200 words. This space includes that occupied by illustrative material as well as by the references and notes.

Limit illustrative material to one 2-column figure (that is, a figure whose width equals two columns of text) or to one 2-column table or to two 1-column illustrations, which may consist of two figures or two tables or one of each.

For further details see "Suggestions to Contributors" [*Science* **125**, 16 (1957)].

Gibberellin-Induced Inhibition of Bud Development in Some Species of *Prunus*

Abstract. Development of both floral and vegetative buds was inhibited by application of gibberellin to branches of *Prunus* species. The development of the lateral meristem was blocked, in general, through inhibition of mitosis, while, concurrently, the growth of certain other plant organs was stimulated in some cases. That higher dosages were required to block vegetative than floral bud growth suggests that gibberellin also exerts the more specific effect of inhibiting floral initiation.

The literature contains various references to stimulation of flowering of certain types of plants after gibberellin application. But only two reports of inhibition of flowering or floral initiation by treatment with gibberellin have come to our attention. When plants of *Kalanchoë blossfeldiana*, a short-day plant, were treated during noninductive conditions, buds appeared at about the same time as on controls in which budding was induced through short days; but few buds developed, and reversal to a vegetative phase ensued (1). In *Weigela* (2), flowering was induced in control plants exposed to the appropriate short-day photoperiod, but plants treated with gibberellin after exposure to that photoperiod failed to flower.

The following report deals with inhibition by gibberellin of both floral and vegetative bud development in certain species of *Prunus*. In photoperiod requirements, *Prunus* is not comparable to the other two genera, for its species are generally considered day-neutral. In one sense, however, the situations in *Prunus* and in *Weigela* were alike, for in both cases gibberellin was applied at times when conditions were otherwise suitable for floral initiation.

The first observations were made in 1957. Branches of apricot (*P. armeniaca* cv. Royal) were sprayed at the initiation of pit-hardening (10 April) with 100, 500, or 1000-mg/lit. concentrations of Gibrel (Merck and Co.), and some of the branches received a second application on 24 April. Branches of sweet cherry (*P. avium* cv. Bing) were treated at a similar phase of development with one application of a 500-mg/lit. concentration. As the season progressed, retardation of bud development on treated branches of both cherry and apricot became apparent. Approximately 15 buds in positions on control spurs normally occupied by floral buds were collected on 24 August from each species, and the same number were collected from spurs which had received an application of 500-mg/lit. concentration. Vegetative buds

from long shoots were also collected. All buds were fixed in Newcomer's solution, embedded, sectioned, and stained with hematoxylin-fast green.

In the apricot, flower buds from controls contained well-defined primordia of sepals, petals, and stamens (Fig. 1a). In buds from treated branches, however, the rounded, rather than flattened, growing points showed that the buds had not attained the initial phase of floral differentiation (Fig. 1b). Bud scales were still being cut off from the growing points, indicating considerable retardation in development; the completion of bud scale formation normally occurs some time before signs of floral differentiation appear. At the time of bloom the following spring practically no flowers developed on any treated branches except on the tips of some long shoots, where the nodes involved probably developed after gibberellin treatment.

In sections of vegetative buds from treated apricot branches, the buds were found to be generally as inhibited in development as the flower buds. Cell division must have been slowed or

blocked early, as indicated by size of the bud in camera-lucida outline in Fig. 1d when compared to the control in Fig. 1c. This is shown more strikingly when the extent of zones of cells considered by staining quality and other cytological features to be capable of division is compared in those figures. Also, in treated buds, fully differentiated parenchyma cells with thick walls, prominent intercellular spaces, and enlarged and presumably endopolyploid nuclei were separated from the zones of cell division by only one or two cell layers. In the control buds, by contrast, many layers of differentiating cells intervened between the cell division zones and the regions where the cells were completely differentiated. The following spring the lethal effects of the gibberellin dosages at and above 500-mg/lit. concentration became apparent in the general failure of vegetative buds to develop.

In the cherry, sections of the compound flower buds from control branches showed the usual one to five individual flower buds among a number of bracts; developing sepals, petals,

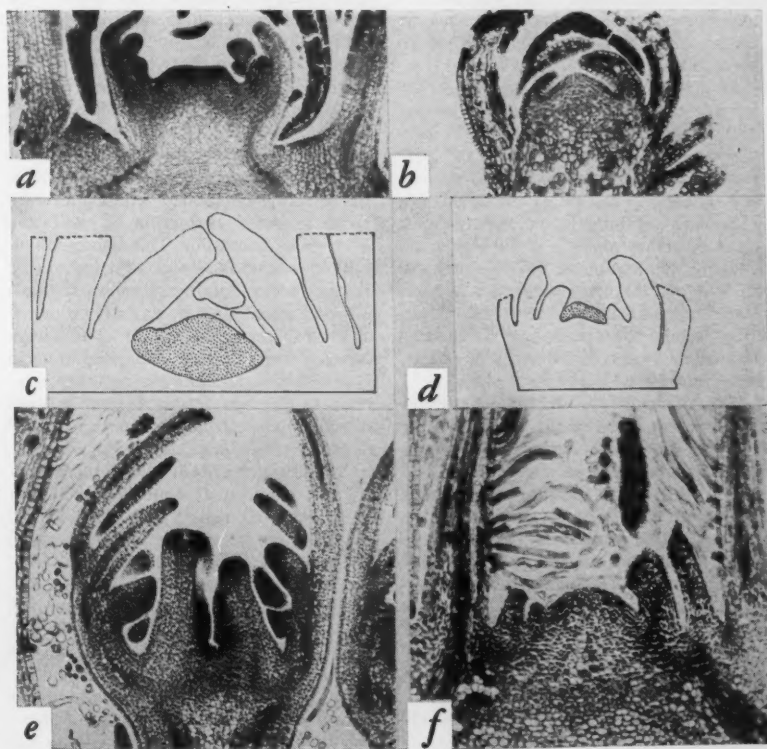


Fig. 1. Median longitudinal sections of buds. (a and b) Flower buds of apricot, from control and treated branches, respectively ($\times 96$). (c and d) Camera-lucida outlines of sections of vegetative buds of apricot, the stippled areas representing the extent of the zones of cells capable of division from a control (c) and from a treated (d) branch ($\times 72$). (e and f) Flower buds of cherry, from control and treated branches, respectively ($\times 96$).

Table 1. Lowest gibberellin dosages causing complete inhibition of bud development in *Prunus* species.

Species	Floral buds		Vegetative buds	
	Mg./lit.	No. of applications	Mg./lit.	No. of applications
Peach	>500	2	>500	2
Apricot	50	2	250	2
Cherry	250	1	>500	2
Almond	50	2	250	2
Plum	50	2	250	2

stamens, and pistils were clearly distinguishable (Fig. 1e). However, none of the buds from treated branches showed signs of even the first phase of floral differentiation. The central regions were occupied by growing points of the vegetative, rather than the floral, form (Fig. 1f). Bracts were still being cut off from the growing points. No primordia of flower buds appeared in the axils of any bracts. The following spring a few flowers were formed, showing that floral differentiation and development had occurred in the exceptional bud. In vegetative buds from treated branches, microscopic structure was indistinguishable from that of control buds. In the spring there was no evidence of any previous damage to these buds.

In 1959, the effects of gibberellin were investigated in almond (*P. amygdalus* cv. Jordanola), plum (*P. domestica* cv. President), and peach (*P. persica* cv. Fay Elberta) as well as apricot and cherry. Treatments included 50, 250, and 500-mg/lit. concentrations; some branches of each species received a single application at full bloom, and other branches were sprayed a second time approximately one week later. [For details of treatment procedures and other types of gibberellin effects, see Crane *et al.* (3)].

The effects of the treatments on bud development were studied in the latter part of September. In all the species floral development in the controls had advanced to stages comparable to those illustrated for the apricot and cherry in the 1957 experiments. More than a dozen buds of treated and control branches were dissected under a stereoscope (×20) to determine whether flower buds had formed and whether vegetative buds appeared capable of survival and future development. Criteria used in the latter evaluation were color (whether a healthy green, or yellowish or brown) and texture (succulent versus granular and partially desiccated). The lowest dosages which inhibited bud development so severely that continuing development was considered unlikely are given in Table 1.

As expected, the five forms of *Prunus* studied here exhibited variation in response to gibberellin dosage. In the peach, two applications of gibberellin, of 500-mg/lit. concentration, were not sufficient to influence floral or vegetative bud development. In the apricot, almond, and plum, however, two applications, of 50-mg/lit. concentration, completely inhibited flower bud development. The cherry was intermediate in its response to dosage.

The inhibition of lateral bud development by gibberellin was not an aspect of general growth restriction. Excessive growth was stimulated in other plant regions; the higher the dosages the more extensive such growth and the greater the bud inhibition. Internodes lengthened in some spurs and long shoots. Stem diameter increased in certain species; in the apricot this was found to result from stimulated cambial activity (4). Petiole length, or diameter, or both, were increased in some cases. In the cherry (the only one of these species in which terminal buds remain viable from year to year), length growth of spurs was stimulated by some gibberellin doses, resulting in about twice the number of nodes as in control spurs. Similarly in some other species, the vegetative bud immediately below the dead terminal bud of a spur developed into a short branch.

Inhibition of cell division was an immediate effect of gibberellin, leading to restriction of lateral bud development. This was apparent from the greatly reduced zones of cells capable of dividing in treated buds, and also from retarded formation of leaf and bud scale primordia. The failure of inhibited vegetative buds to survive and develop the following year suggests either a toxic effect or one of prolonged starvation, either of which could have blocked cell division. The situation in lateral buds of *Prunus* is in sharp contrast to that in terminal buds of the rosette plants *Hyoscyamus niger* and *Samolus parviflorus*, in which gibberellin greatly stimulated mitosis in subapical regions (5). It contrasts also with the stimulated cell division implicit in excessive growth of terminal buds in the cherry after gibberellin treatment. Apparently physiological or anatomical differences, or both, between terminal and lateral buds may influence the effects of gibberellin. In *Prunus*, lateral bud inhibition can scarcely be considered a matter of intensified apical dominance, as indicated by the following evidence. When excessive terminal growth of cherry shoots was stimulated, development of lateral vegetative buds was not blocked. Also, in other species, when the first subterminal vegetative bud on a spur failed to develop, even

after high gibberellin doses, the other lateral buds were nevertheless inhibited.

That gibberellin may have blocked floral initiation by affecting other processes than those concerned with cell division alone is suggested by the inhibition of floral bud development by considerably lower dosages than those required to suppress vegetative bud development. Reasons for considering floral initiation, rather than floral differentiation, as the blocked phase are as follows. Gibberellin was applied during the floral initiation period in both years. The interval between floral initiation and differentiation is 3 months in cherry, 4 in peach and plum, and 6 months in apricot and almond (6). An all-or-none effect in flower bud formation was noted; all treated floral buds examined were either as advanced in development as controls, or showed no evidence that floral differentiation had begun. It appears, therefore, that gibberellin may have interfered in some manner with processes concerned in floral initiation.

MURIEL V. BRADLEY
JULIAN C. CRANE

Department of Pomology,
University of California, Davis

References

1. R. Harder and R. Bünsow, *Naturwissenschaften* 43, 544 (1956).
2. H. Davidson and M. J. Bukovac, *Am. Soc. Hort. Sci.*, 56th Ann. Meeting, Abstr. No. 361, 61 (1959).
3. J. C. Crane, P. E. Primer, R. C. Campbell, *Proc. Am. Soc. Hort. Sci.*, in press.
4. M. V. Bradley and J. C. Crane, *Science* 126, 972 (1957).
5. R. M. Sachs and A. Lang, *Science* 125, 1144 (1957); R. M. Sachs, C. Bretz, A. Lang, *Exptl. Cell Research* 18, 230 (1959).
6. W. P. Tufts and E. B. Morrow, *Hilgardia* 1, 1 (1925).

2 November 1959

The Sun Azimuth Compass: One Factor in the Orientation of Homing Pigeons

Abstract. In accordance with the theory of the sun azimuth compass (1), displaced homing pigeons are misled in a predictable way if their "internal clock" has been reset by exposure to a time-shifted sequence of day-night cycles.

Several species of birds have been trained to respond to particular compass directions in stationary training cages (2). By resetting the birds' chronometers, or "internal clocks," predictable deviations from the training direction were obtained (3, 4). The question as to whether homing by free flying pigeons could be influenced in a similar manner has not previously been clearly answered, the relevant experiments (5) having been inconclusive.

Recent work at Wilhelmshaven, Germany, and Durham, North Carolina, has answered this question. The results described below were obtained from 55 releases under sunny conditions over a period of 4 years. In Fig. 1A, results from Germany are involved exclusively; in Fig. 1B and 1C, about 21 percent of the results were obtained in North Carolina. For each release, two groups of about 18 pigeons each were prepared simultaneously in the following manner: both experimental and control flocks were placed in separate, light-proof rooms, within which artificial day-night cycles could be provided. For the experimentals tabulated in Fig. 1A, light was switched on and off 6 hours earlier than sunrise and sunset, respectively; for those in Fig. 1B, 6 hours later than sunrise and sunset, respectively; and for those in Fig. 1C, the day-night sequence was completely reversed (shifted 12 hours). The control flock was provided with a light-dark schedule which followed the natural day. For releases involving 6 hours of time shift, both groups were confined for at least 4 full days; for a shift of 12 hours, they were confined for at least 7 days. Preliminary work had shown that these periods were sufficiently long for shifting to take full effect (4).

All of the birds, in groups containing roughly equal numbers of experimentals and controls, were displaced to release points in various directions from home and at distances varying from 5.5 to 100 miles from home. The releases were timed to fall within the light period which the artificial and the natural day had in common. Experimental and control birds were released singly and alternately, and were followed with field glasses to determine their bearings until they vanished. Observers at the loft recorded arrival times of the birds which were individually marked.

Even normal pigeons almost never head exactly in the actual direction of home. Influences, so far unknown, cause deviations which vary from one place to another but which are, within certain limits, characteristic of each release point. At three release points out of the 17 involved in this report, the mean local deviations from the home direction exceeded 55°; at 14 release points they ranged up to 55° right or left of the true home direction. Therefore, the departures are clearly oriented in the general direction of home, but for a strictly experimental basis of comparison, the bearings of the experimental birds at vanishing are plotted in Fig. 1 with reference to the combined mean vanishing bearings of the controls and not to the actual home

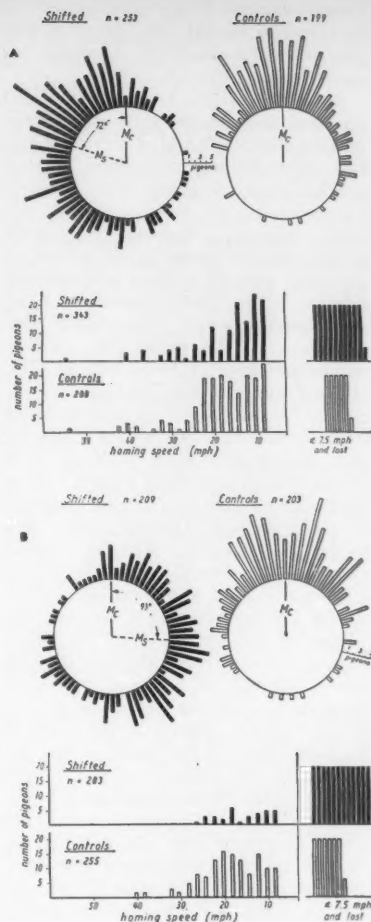


Fig. 1. Summary of departures at vanishing point and homing speed of pigeons (experimentals, solid bars; controls, open bars). The lengths of the bars are proportional to the number of birds that vanished at the bearing indicated (circular graphs) and that homed at the speed indicated (rectangular graphs). Birds that homed at less than 7.5 mi/hr or that were lost are grouped at the right. A, Pigeons subjected to a day beginning and ending 6 hours early. The mean departure direction of the experimentals (M_d) at the vanishing point was 72° to the left of that of the control birds (M_v). B, Pigeons subjected to a day beginning and ending 6 hours late. The mean departure direction of the experimentals was 93° to the right of that of the control birds. C, Pigeons subjected to a day shifted 12 hours. The mean departure direction of the experimentals was 168° to the right of that of the controls.

direction. The figures therefore give the mean deviation of the experimentals. But they show a falsified degree of scatter of the experimentals as compared with the controls, because the average deviation of the experimentals varies somewhat among separate releases. If one summarizes the mean scatter of each single release, the experimentals turn out to have only a slightly increased scatter.

Extrapolating from the results obtained from the stationary cage experiments (4), we would expect the birds whose day had been advanced 6 hours to deviate about 90° to the left of the controls, while those whose day had been retarded 6 hours should deviate 90° to the right, and the reversed-day birds should shift 180° from the direction chosen by the controls. The departures summarized on the accompanying graphs show that this expectation is largely realized. This fact is underscored by a drastically decreased homing performance among the experimentals. Reports on the lost experi-

mentals show that they continued to move roughly in the direction chosen when they were released (4). Clearly, then, the sun azimuth compass is one basic mechanism in pigeon orientation. However, a small proportion of experimentals were able to home rapidly despite their shifted day. These statements suggest that other factors, as yet unknown, may be operative as well.

Nevertheless, by supporting the postulated function of the sun azimuth compass, the findings could be interpreted according to Kramer's idea of "map and compass" process (6) in which orientation is supposed to consist of two steps, one establishing the geographical position of displacement and the other defining compass directions. About the first step we do not yet know anything (7).

KLAUS SCHMIDT-KOENIG
Max-Planck-Institut für
Verhaltensphysiologie, Wilhelmshaven,
Germany, and Department of Zoology,
Duke University, Durham,
North Carolina*

References and Notes

1. G. V. T. Matthews, *Bird Navigation* (Cambridge Univ. Press, New York, 1955); G. Kramer, *Ibis* 99, 196 (1957).
2. G. Kramer and U. v. St. Paul, *Naturwissenschaften* 37, 526 (1950); G. Kramer and E. Riese, *Z. Tierpsychol.* 9, 245 (1952); U. v. St. Paul, *Auk* 73, 203 (1956).
3. K. Hoffmann, *Z. Tierpsychol.* 11, 453 (1954).
4. K. Schmidt-Koenig, *Ibid.* 15, 301 (1958); also material in preparation.
5. K. Rawson and A. Rawson, unpublished; G. V. T. Matthews, *J. Exptl. Biol.* 32, 39 (1955).
6. G. Kramer, *J. Ornithol.* 94, 201 (1953).
7. This work was supported by the Deutsche Forschungsgemeinschaft and by the Office of Naval Research under a contract (NR 301-244) with Duke University. I am very much indebted to the late Dr. G. Kramer and to Dr. J. G. Pratt and Dr. H. Mittelstaedt for facilities and discussion.

• Present address.

14 October 1959

Adaptation of Cardiac Output to Peripheral Runoff Studied in Intact Dogs

Abstract. A pump with sinusoidal piston movement was connected to the abdominal aorta of intact anesthetized dogs, causing slow oscillations of arterial blood pressure. Evidence was found for the existence of a mechanism which enables the heart to adjust its output immediately to changes of peripheral outflow.

In previous publications (1) Wetterer and I described a method by which we produced slow, nearly sinusoidal oscillations of the arterial pressure in intact anesthetized dogs. At that time it became apparent that these oscillations do not cause any reflex activity in the cardiovascular system and that the vasomotor tone is unchanged. Since recent studies of the performance of the heart (2) emphasize the importance of experimentation in intact animals as compared to

experimentation in preparations such as Starling's, it became obvious to us that this method would be most suitable for such studies.

Twelve experiments were performed on large dogs anesthetized with 30 mg of Nembutal, or 3 mg of morphine sulfate, plus 200 mg of sodium barbital per kilogram. A pump with a nearly sinusoidal piston movement (a specially adapted Harvard respiration pump) was connected to the abdominal aorta by way of a short polyethylene tube of 3.2-mm inside diameter via the right femoral artery. The volume displacement of the pump was variable within the range of 50 to 100 ml. The piston movement was continuously recorded by means of a linear differential transformer. The pump was operated with frequencies from 0.18 to 0.30 cy/sec and in operation caused a slow oscillation of the mean arterial pressure by alternately taking out and reinjecting blood. Arterial blood pressure was measured in the aortic arch by means of a miniaturized catheter tip manometer with a natural frequency of 500 cy/sec (3). The manometer was introduced through the left femoral artery. A catheter tip flowmeter with a natural frequency of 160 cy/sec (4) was placed in the ascending aorta close to the aortic valves by way of the left carotid artery. Clotting was prevented by the injection of 5 mg of heparin per kilogram. Calibration of the flowmeter was accomplished *in situ* by taking simultaneous dye-dilution curves (5). Zero flow in the ascending aorta was obtained by arresting the heart for a few seconds by stimulation of the left vagus nerve.

Our recordings taken during operation of the pump show that the oscillation of the aortic pressure, while ac-

companied by significant changes of aortic flow, is not reflected in the pressure in the right atrium. They demonstrate further that operation of the pump does not cause any changes in heart rate. This, as well as the fact that the arterial pressure after the pump is stopped returns within 1 second to the level recorded before the pump was started, indicates that the pressure oscillation does not produce reflex changes in the circulatory system.

For the evaluation of the recordings the area under the curve of the aortic flow, which was taken as a measurement of cardiac output, was measured with a planimeter, and each stroke volume was calculated. The volume exchanges of the pump were derived from recording the piston movement.

It was found that for any given diastolic aortic pressure, the algebraic sum of cardiac output and volume injected or withdrawn by the pump during the same systole was a constant. This is shown in Fig. 1A, where stroke volume plus pump volume is plotted against diastolic aortic pressure P_d . It can be seen that values which were obtained with three different pump frequencies follow closely the same line. This shows that although the rate of inflow or outflow produced by the pump was greatly changed by changing the pump frequency, any variation of total systolic inflow into the arterial system was fully and immediately compensated by the heart. Since the effect of the pump represents in a sense a continuous change of the peripheral outflow such as would result from a change of the peripheral resistance, one must conclude that this mechanism adjusts cardiac output immediately to changes in peripheral outflow.

The constancy of the total systolic inflow for a given diastolic pressure must necessarily lead to a constancy of the aortic pressure pulse with respect to this diastolic pressure, since, as stated above, the vasomotor tone and therefore all other parameters, such as the systolic runoff and the elasticity coefficient of the arterial system, are unchanged by the operation of the pump. This is demonstrated in Fig. 1B, where systolic aortic pressure P_s is plotted against diastolic pressure P_d in order to show values obtained during injection as well as withdrawal of the pump. The ratio P_s/P_d was found to be changed only during the brief periods of respiration of the animal, where systolic pressure rose to relatively higher values. Therefore, only pressure cycles without respiratory activity were evaluated (6).

HEINZ P. PIEPER

Department of Physiology,
Ohio State University, Columbus

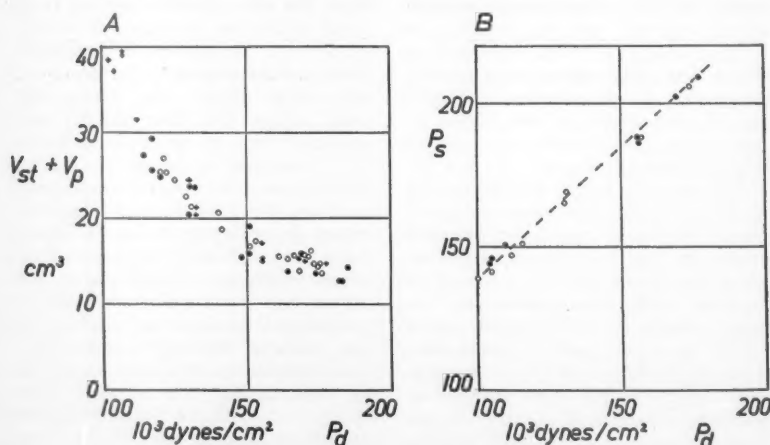


Fig. 1. (A) Stroke volume plus pump volume ($V_{st} + V_p$) plotted against diastolic aortic pressure P_d . Values for three different pump frequencies: +, 0.28 cy/sec; ●, 0.22 cy/sec; ○, 0.16 cy/sec. (B) Systolic aortic pressure P_s plotted against diastolic aortic pressure P_d ; ○, during withdrawal; ●, during injection of pump.

References and Notes

1. E. Wetterer and H. Pieper, *Z. Biol.* **106**, 23 (1953); —, *Verhandl. Deut. Ges. Kreislauforsch.* **19**, 259 (1953); H. Pieper and E. Wetterer, *ibid.* **21**, 439 (1955); E. Wetterer and H. Pieper, *ibid.* **21**, 430 (1955).
2. R. F. Rushmer and O. A. Smith, Jr., *Physiol. Revs.* **39**, 41 (1959); R. F. Rushmer, O. A. Smith, Jr., D. Franklin, *Circulation Research*, **7**, 602 (1959); R. F. Rushmer, *Am. J. Physiol.* **196**, 745 (1959).
3. E. Wetterer and H. Pieper, *Z. Biol.* **105**, 49 (1952).
4. H. P. Pieper, *Rev. Sci. Instr.* **29**, 965 (1958).
5. W. F. Hamilton, J. W. Moore, J. M. Kinsman, R. G. Spurling, *Am. J. Physiol.* **99**, 534 (1932).
6. This research was supported in part by a grant from the Central Ohio Heart Association.

10 November 1959

Primary Site of Gene Action in Anterior Pituitary Dwarf Mice

Abstract. The transplantation of anterior pituitary glands of normal mice into hypophysectomized dwarf littermates has resulted in mice that are normal in appearance and growth rate. In contrast, the anterior pituitary gland of dwarf animals, when placed in the sella of hypophysectomized normal littermates, failed to promote the growth of these animals. These results indicate that the primary site of gene action in dwarfism lies in the anterior pituitary itself rather than in the hypothalamus.

The dwarf mouse has been used extensively in a variety of endocrine studies. Snell (1) demonstrated that the dwarfism is the result of a single recessive gene that is not sex-linked. The immediate cause of dwarfism is the failure of the anterior pituitary gland to function in the production of growth hormone. Smith and MacDowell (2) were the first to suggest this cause after observing the hypoplastic nature of the

anterior pituitary lobe, the sexual glands, and the adrenal cortex. These two investigators produced dwarf mice that were normal in growth and appearance following daily implants of normal rat pituitaries. Kemp and Marx (3) demonstrated normal growth and appearance of dwarf mice following daily injections of anterior pituitary extracts. Francis (4) studied the cytology of the pituitary of the hereditary dwarf in some detail and confirmed earlier studies which related the dwarfism to an absence of typical acidophiles and a deficiency of growth hormone. Current interest in hypothalamic-anterior pituitary interrelationships directed our attention to the possibility that the primary site of gene action might lie in the hypothalamus rather than in the anterior pituitary per se.

In order to answer this question we have transplanted anterior pituitary glands between normal and dwarf members of litters whose parents were heterozygous for the dwarf gene. Our experiments were so designed that the activity of the anterior pituitary homographs could be observed by daily weighings and resultant growth curves. Using littermates, we hypophysectomized normal mice (14 to 18 days old) by the parapharyngeal method. A dwarf littermate of like sex was killed, and its pituitary was placed immediately into the sella of the hypophysectomized normal littermate. The transplanted pituitaries were held in place against the hypothalamus by Gelfoam sponge (Upjohn), and the incision was closed with silk sutures. In this manner, transplants were made from dwarf mice to normal mice, from normal mice to dwarf mice, and from normal mice to normal mice. There were five animals in each of these groups. The growth of these animals and that of five unoperated dwarf and five unoperated normal mice was determined by daily weighings for a 30-day period (20th day through the 50th day). Growth curves representing these five groups of mice were then made.

Our observations were as follows (Fig. 1). (i) Unoperated normal mice gained 15.5 gm. (ii) Unoperated dwarf mice gained 4.4 gm. (iii) Hypophysectomized normal mice bearing transplants from normal mice gained 8.7 gm. (iv) Hypophysectomized normal mice bearing transplants from dwarf mice gained 2.8 gm. (v) Hypophysectomized dwarf mice bearing transplants from normal mice gained 6.7 gm.

More important than the total weight gain is the rate of weight gain. The rate of weight gain in hypophysectomized dwarf mice bearing pituitaries of normal mice was almost equal to the rate of growth of hypophysectomized normal mice bearing pituitary transplants from normal mice. On the other hand, the

rate of weight gain of hypophysectomized normal mice bearing pituitaries of dwarf mice was even less than the rate of growth of unoperated dwarf mice.

These results indicate that the hypothalamus of the hereditary dwarf mouse is capable of stimulating a pituitary graft from a normal animal to function at a level comparable to that seen in normal animals bearing similar pituitary grafts. It is noteworthy that the dwarf mouse, when given a normal anterior pituitary as an intrasellar graft, comes to resemble a normal mouse in rate of growth and in physical appearance. Also, the evidence obtained indicates that the pituitary of the dwarf mouse is incapable of producing significant amounts of growth hormone, even when it is placed in contact with the hypothalamus of a normal animal. This shows rather clearly that the anterior lobe of the pituitary and not the hypothalamus is the primary site of gene action in the anterior pituitary dwarf mouse.

ROBERT L. CARNSER
EDWARD G. RENNELS

Department of Anatomy, University of Texas Medical Branch, Galveston

References and Notes

1. G. D. Snell, *Proc. Natl. Acad. Sci. U.S.A.* **15**, 733 (1929).
2. P. E. Smith and E. D. MacDowell, *Anat. Record* **46**, 249 (1930); **50**, 85 (1931).
3. T. Kemp and L. Marx, *Acta Pathol. Microbiol. Scand.* **13**, 512 (1936); **14**, 197 (1937).
4. T. Francis, *The Development of the Pituitary and Hereditary Anterior Pituitary Dwarfism in Mice* (Munksgaard, Copenhagen, Denmark, 1944).
5. This study was supported by grants 2R-29 and RG-4723 from the U.S. Public Health Service.

3 August 1959

Heterogeneity of Ion Exchange Resins

Abstract. The density gradient method of Linderström-Lang has been used to study density variations among swollen beads in batches of cation exchange resin. Solutions of salts such as sodium tungstate which have dense anions are used. Certain commercial resins appear to be very uniform in cross linking and sulfonation.

A report by Högfeldt (1) shows that individual beads in a batch of ion exchange resin can differ widely in their characteristics. Beads taken from a batch of sulfonated polystyrene resin with a nominal 4 percent of cross linking showed selectivities for silver ions against hydrogen ions which varied by a factor of more than 2. Parallel variations were found in the swelling. These could be due to differences in cross linking, sulfonation, or both.

In our laboratory we are studying the thermodynamics of ion exchange,

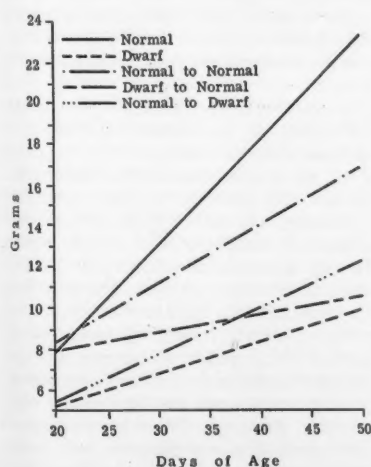


Fig. 1. Growth curves of intact and pituitary graft-bearing mice of the genetic dwarf strain. Each curve represents pooled data obtained from a group of five animals.

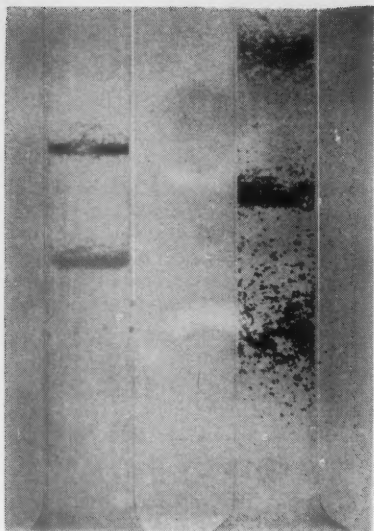


Fig. 1. Density gradient tubes with ion exchange resins in sodium tungstate solutions. (Left) Dowex 50-W. (Right) Laboratory preparations of sulfonated polystyrene resins.

and the homogeneity of the resins used is obviously very important. We have used the density gradient method of Linderström-Lang (2) to study this homogeneity. A tube was set up which had two bulbs, each of about 100-ml capacity, joined by a vertical tube 2.5 cm in diameter and 18 cm long. A solution of sodium tungstate which was dense enough to float the resins was poured into the lower bulb and the lower half of the vertical tube. Over this, filling the upper bulb, was poured a more dilute solution of sodium tungstate which was not dense enough to float the resins. The tube was set in a thermostat at $25^\circ \pm 0.01^\circ\text{C}$ and left for 2 days. The solutions mixed by diffusion, and a stable gradient of concentration and density was established along the length of the vertical tube.

Small portions (about 50 mg) of the resins to be studied were then dropped into the tube. These were sulfonated

polystyrene resins converted to the sodium form and air-dried. Within an hour they came to rest within the vertical tube, the more highly cross-linked resins settling further down the tube, and they remained in the same position for days.

Figure 1 is a photograph of two such tubes. On the left are two commercial resins supplied by the Dow Chemical Co. (Dowex 50-W, 50–100 mesh), with 4 and 8 percent cross linking, respectively; the 4-percent cross-linked resin is on top. As may be seen, these resins are remarkably uniform, though both contain a small amount of light material which floats just above the main quantity of resin. On the right are three laboratory-scale batches with nominal 7, 10, and 17 percent cross linking, respectively. These are less homogeneous.

To determine the density distributions in the vertical tubes, small portions of solution (0.2 to 0.5 ml) were withdrawn from measured levels by a pipet with a long capillary tip, and their densities were measured by a micro-pyknometer. Or, their refractive indices were measured and compared with those of solutions of known concentration and density. Typical data are given in Table 1.

Sodium tungstate (Na_2WO_4) was chosen as the heavy solute because it is the anion which is dense, and anions are partially excluded from a cation exchange resin. Another heavy solute which worked well was disodium lead ethylenediamine tetraacetate (Na_2PbY).

The density at which the resin floats is determined by its swelling, which in turn depends on two factors, cross linking and extent of sulfonation. The "laboratory batch" resins were somewhat lighter than the commercial resins of comparable cross linking, a finding which suggests that they were more highly sulfonated. That this was, in fact, the case is seen from the ion-exchange capacities reported in Table 1. A resin could appear homogeneous by the flotation test yet not be truly homogeneous; by using more than one flotation solute it may be possible to

distinguish between the effects of cross linking and sulfonation.

The flotation technique has obvious potentialities for producing very uniform batches of resin (3).

M. G. SURYARAMAN
H. F. WALTON

Department of Chemistry,
University of Colorado, Boulder

References and Notes

1. E. Högfeldt, *Science* **128**, 1435 (1958); *Arkiv Kemi* **13**, 491 (1959).
2. K. Linderström-Lang, *Nature* **139**, 713 (1937).
3. This work was supported by the U.S. Atomic Energy Commission [contract AT (11-1)-499]. The laboratory batches of resin were provided by C. Calmon of the Permutit Company, whom we wish to thank.

29 October 1959

Zinc-65 in Cyclotron Workers

Abstract. Small but persistent body burdens of zinc-65 have been found in cyclotron workers. This radionuclide and others are produced by nuclear reactions with the construction materials of the cyclotron. Only zinc-65 has gained entry into the body, but in amounts of less than 1 percent of the maximum permissible amount.

Measurement of Los Alamos Scientific Laboratory cyclotron workers in November 1958 in the human counter (1), a large liquid scintillator designed for detection of radioactivity in human beings, revealed the presence of radioactivity in excess of normal potassium-40 activity in the 1- to 2-Mev region. This excess was identified as zinc-65 in the Los Alamos human spectrometer (2), a large NaI (Tl) crystal in a steel room by means of which radioactivity in human beings can be characterized. Figure 1 is a typical spectrum showing the characteristic zinc-65 peak at 1.11 Mev in addition to the usual cesium-137 and potassium-40 peaks.

Zinc-65 can be produced in large quantities in cyclotrons accelerating deuterons by the reaction $\text{Cu}^{65}(d, 2n)\text{Zn}^{65}$ on copper dees and other parts. In fact, this reaction has been used for producing zinc-65 of high specific activity (3) for biological tracer work. In the acceleration of helium-3 ions, lesser amounts result from the reaction $\text{Cu}^{65}(\text{He}^3, \text{H}^3)\text{Zn}^{65}$, and in addition the reaction $\text{C}^{12}(\text{He}^3, 2\text{He}^4)\text{Be}^7$ may occur if carbon (as graphite, oil, grease, and so on) is bombarded. Deuteron reactions on iron, chromium, and manganese can produce manganese-54, which also results from the p, n reaction on chromium-54. The properties of these radionuclides are summarized in Table 1. The Los Alamos variable-energy cyclotron is used to produce beams of protons (3.9 to 9 Mev), deuterons

Table 1. Concentrations, densities, and refractive indices of solutions floating sulfonated polystyrene ion-exchange resins.

Resin		Na ₂ WO ₄			Na ₂ PbY		
Cross-linking (%)	Exchange capacity*	Sp. gr. (25°C)	<i>n</i> _{25 D}	WO ₃ (wt.%)	Sp. gr. (25°C)	<i>n</i> _{25 D}	Pb (wt.%)
Dowex 50-W							
4	4.78	1.302	1.3688	28.0	1.298	1.3960	13.35
8	4.48	1.338	1.3718	30.65	1.333	1.4016	14.92
Laboratory batches							
7	4.60	1.322	1.3701	28.2			
10	4.425	1.347	1.3728	31.55			
17		1.383	1.3768	35.0			

* Exchange capacities are in milliequivalents per gram of dry sodium resin.

(6.2 to 15 Mev), helium-3 ions (9.3 to 24 Mev), and helium-4 ions (13.4 to 32 Mev). The copper dees are approximately 20 in. in radius and have 1/8-in. graphite liners to reduce induced radioactivity. Other parts [deflector, exit strips (septum), ion source cone, and feeler] exposed to beam bombardment contain chromium-plated copper and graphite. Hence, manganese-54 and beryllium-7 are possible products, in addition to zinc-65.

A repair operation in which the machine is opened and the dees are removed is referred to as a "rollback" at this laboratory. When this occurs, a major clean-up usually follows. Many parts are found to have carbon deposits and other foreign material. Cleaning these parts by use of solvents, grinding, or sanding contaminates the air, as shown by air samplers (4). Indeed, it appears that just opening the machine causes air contamination.

During rollbacks, gamma-ray spectra of filter papers from the air samplers have shown zinc-65 and, in addition, peaks very close to the energy of beryllium-7 (0.48 Mev) and manganese-54 (0.84 Mev). The surface of a nearby workbench top showed the same radioactivities, as did the cyclotron deflector and ion source holder. If the 0.48 Mev peak was actually beryllium-7, then beryllium-7 and zinc-65 were the predominant radionuclides observed, and their abundances were comparable. Tools (a screwdriver and so on) were similarly contaminated; the amount of zinc-65 was of the order of 0.1 μ c.

Gamma-ray spectra of several of the cyclotron personnel most involved in rollback operations have been measured serially since the exposure was discovered in November 1958. These data are shown in Fig. 2. The maximum body burdens observed were about 0.1 μ c, a burden which is quite trivial compared with the maximum permissible body burden of 60 μ c (5). Recontamination has undoubtedly occurred in the interval studied, due to rollbacks and general area contamination, as the data show. However, the results are consistent with the information on zinc-65 metabolism recently obtained at this laboratory (6). Doses administered orally were efficiently absorbed, and retention ranged from 50 to 80 percent several months after ingestion; urinary excretion several weeks after ingestion was only about 0.05 to 0.1 percent of the body burden. Analysis of urine samples of the five cyclotron workers listed in Fig. 2 showed that if any zinc-65 were present, the amount was less than 0.2 to 0.3 percent of the body burden in a 24-hour sample. It is interesting to note that only once did the cyclotron personnel show any radioactivity other than zinc-65 and the

Table 1. Properties of some cyclotron-produced radionuclides.

Isotope	Mode of decay	$T_{1/2}$ (days)	E_γ (Mev)	N_γ/N_α	Air MPC* for 40-hr wk (μ c/cm ³)
Be ⁷	E.C.	53	0.48	0.12	10 ⁻⁵
Mn ⁵⁴	E.C.	291	0.84	1.00	8 \times 10 ⁻⁷
Zn ⁶⁵	E.C. (98%) β^+ (2%)	245	1.11	0.51	10 ⁻⁷

*Maximum permissible concentration.

usual cesium-137 and potassium-40 activity. This was at the end of June 1959, when they showed a peak at 0.46 Mev, which is very close to the beryllium-7 energy. This may have been from skin or hair contaminants subsequently washed off.

To minimize recontamination during rollbacks when particulate matter may become airborne, protective shoe coverings, gloves, coveralls, caps, and respirators are used. The routes of entry into the body have not been determined with certainty, but probably one means of contamination is inhala-

tion. All the personnel were fitted for respirators (the half-mask type being preferred by the group). External exposure has been kept within permissible levels through shielding, distance, and limitation of working time.

It is probable that many cyclotron workers and perhaps individuals working on other accelerators (or reactors) have small burdens of zinc-65. Such burdens have been reported in two cyclotron workers at Massachusetts Institute of Technology (7). It would be of interest to survey those potentially exposed at other installations, from the

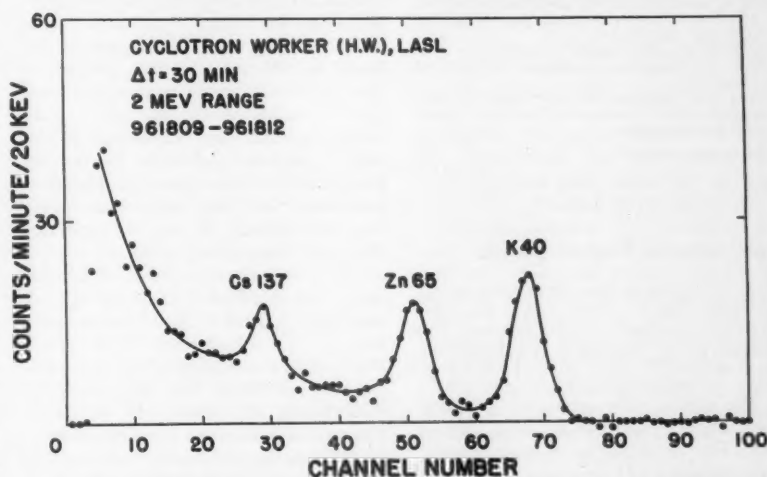


Fig. 1. Gamma-ray spectrum of cyclotron worker (H.W.) with zinc-65 burden.

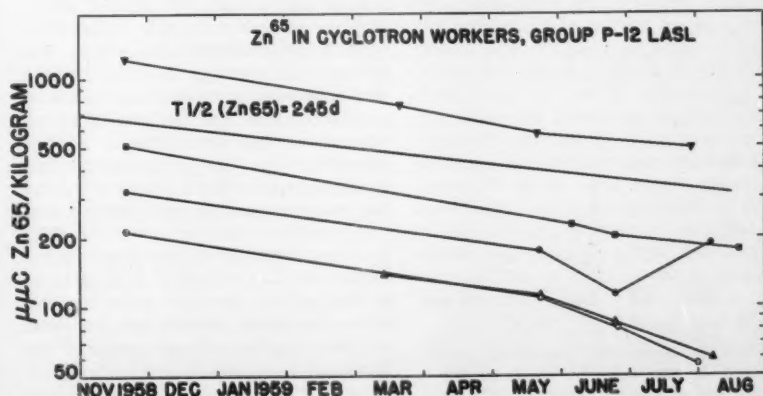


Fig. 2. Body content of zinc-65 as a function of time in five cyclotron workers (▼, D.A.; ■, H.W.; ●, R.C.; ○, D.C.; and ▲, J.N.).

standpoint of good health-physics practice and for better understanding of the metabolism of radionuclides in the human body. To make such surveys is becoming increasingly easier, since human spectrometers and whole-body counters have been or are being built at many universities and atomic energy installations throughout the world (8).

M. A. VAN DILLA
M. J. ENGELKE

Los Alamos Scientific Laboratory,
Los Alamos, New Mexico

References and Notes

1. E. C. Anderson, *IRE. Trans. on Nuclear Sci.* NS-3, No. 4, 96 (1956).
2. E. C. Anderson and M. A. Van Dilla, *IRE. Trans. on Nuclear Sci.* NS-5, No. 3, 194 (1958); M. A. Van Dilla, *Neucleonics* 17, No. 11, 150 (1959).
3. C. J. Maletskos and J. W. Irvine, *J. Chem. Phys.* 19, 796 (1951).
4. HV-70 filter paper, manufactured by Hollingswood and Vose, Co., East Walpole, Mass., was used.
5. "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure," *Natl. Bur. Standards Handbook No. 69* (1959).
6. C. R. Richmond, W. H. Langham, M. A. Van Dilla, Los Alamos Scientific Laboratory, unpublished data (1959).
7. Annual progress report, Massachusetts Institute of Technology, contract AT(30-1)-952 (May 1959).
8. The work discussed in this report was performed under the auspices of the U.S. Atomic Energy Commission.

2 November 1959

Laminarase of *Euglena gracilis*

Abstract. An enzyme in extracts of the protistan *Euglena gracilis* splits the polysaccharide laminarin (β -1:3-glucosan). Its optimal pH is 5.0, and it is activated by Mn^{++} ions.

The storage polysaccharide (paramylon) of the protistan *Euglena gracilis* has been reported to be a β -1:3-glucose polymer (1) probably very similar in structure to laminarin (2), a

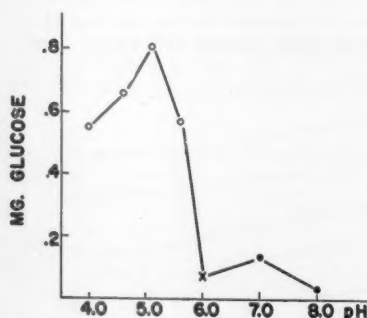


Fig. 1. Effect of pH on activity of *Euglena* laminarase. Assay was carried out as described in the text, but without Mn^{++} . Final buffer concentration, 0.1M. Open circle, acetate; cross, phosphate; solid circle, "Tris" (7).

polysaccharide produced in large quantities by several species of Phaeophyceae (brown algae), notably *Laminaria* (3). Because of this similarity it seemed of interest to look for a laminarin-splitting enzyme in *Euglena*. Laminarase has been described in extracts of higher plant tissues (4, 5).

Euglena gracilis (strain Z, Indiana collection strain No. 753) was grown as described elsewhere (6). The cells were harvested by centrifugation, suspended in approximately 5 vol of acetone at -15°C , homogenized for 30 seconds in a Waring blender, collected by filtration and washed with additional cold acetone, and given a final ether wash until most of the chlorophyll had been removed. The acetone powder was further dried overnight under reduced pressure. Extraction of the enzyme was carried out by stirring 5 gm of the *Euglena* acetone powder for 4 hours at 4°C in 50 ml of 0.04M acetate buffer, pH 6.0, containing NaCl at a concentration of 0.5M and Versene at 0.002M. The extract was dialyzed overnight against 0.01M "Tris" buffer (7), pH 7.3. The laminarase assay was based on the colorimetric determination of the reducing groups liberated by the action of the enzyme on the polysaccharide with 3,5-dinitrosalicylic acid, a reagent much used for the determination of amylase (8). The final conditions of the laminarase assay were as follows: 5 mg of laminarin (9) was incubated with occasional stirring for 2 hours at 37°C with 0.25 ml of the *Euglena* extract, in a final volume of 1.0 ml of 0.1M acetate buffer, pH 5.1, containing 10^{-3}M Mn^{++} . The reaction was stopped by the addition of 1.0 ml of the dinitrosalicylic acid reagent (8) and 3 ml of water. The excess laminarin was removed by centrifugation, and the supernatant was heated in a boiling-water bath for 5 minutes. After cooling, the volume was adjusted to 10 ml, and the color intensity was determined with a Klett-Summerson photoelectric colorimeter with a green filter (No. 54). The amount of reducing material liberated was expressed as milligrams of glucose.

The optimal pH of the *Euglena* laminarase was found to be 5.0, as shown in Fig. 1. It is of interest that the same value has been reported for the enzyme from higher plant tissues (5). Another similarity was the relative heat lability of the *Euglena* enzyme: at 55°C and pH 7.3, 61 percent of the activity was lost in 4 minutes, while complete inactivation occurred within 8 minutes. A time course of the laminarase reaction is given in Fig. 2. When the effects of various metal ions on the enzyme were tested Fe^{+++} , Cr^{+++} , Ni^{++} , Ba^{++} , and Mg^{++} were

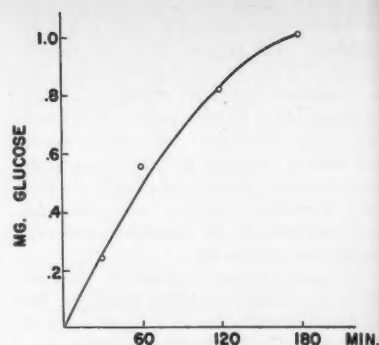


Fig. 2. Time course of laminarase reaction. Assay was carried out as described in the text, but without Mn^{++} .

found to be slightly inhibitory or inactive, while Hg^{++} was strongly inhibitory at concentrations of 10^{-4} and 10^{-3}M . It was of particular interest that 10^{-4} and 10^{-3}M Mn^{++} strongly stimulated the enzyme. Activations from 50 percent to over 100 percent, depending on the enzyme preparations, were observed. Smaller activations resulted from the addition of Co^{++} or Ca^{++} at the same concentrations.

Fractionation experiments now in progress tend to indicate that more than one enzyme may be involved in the breakdown of laminarin. Examination of the products of the enzymatic degradation may further clarify this point. In *Euglena*, it appears that laminarase probably serves to mobilize the reserve carbohydrates, especially since we were unable to find any amylase activity in the organisms (10).

J. FELLIG

Research Department,
Union Carbide Chemicals Company,
South Charleston, West Virginia

References and Notes

1. D. R. Kreger and B. J. D. Meuse, *Biochim. et Biophys. Acta* 9, 699 (1952).
2. J. J. Connell, E. L. Hirst, E. G. V. Percival, *J. Chem. Soc.* 1950, 3494 (1950); S. Peat, W. J. Whelan, H. G. Lawley, *ibid.* 1958, 724, 729 (1958).
3. W. A. P. Black, *J. Soc. Chem. Ind. (London)* 67, 165, 169, 172 (1948).
4. T. Dillon and P. O'Colla, *Nature* 166, 67 (1950).
5. —, *Chem. & Ind. (London)* 1951, 111 (1951).
6. M. K. Bach, *J. Protozool.* 7, 50 (1960).
7. "Tris" is the abbreviation for tris(hydroxymethyl)aminomethane, a product of Sigma Chemical Company, St. Louis, Mo.
8. P. Bernfeld, in *Methods in Enzymology*, S. P. Colowick and N. O. Kaplan, Eds. (Academic Press, New York, 1955), vol. 1, p. 149.
9. We wish to thank Stanley Peat, University College of North Wales, Bangor, and E. T. Dewar, Institute of Seaweed Research, Inveresk, Midlothian, for their generous gifts of laminarin.
10. We wish to thank M. K. Bach of this department for advice and help in growing the *Euglena*. The competent assistance of Mary B. Wall is gratefully acknowledged.

4 November 1959

Meetings

Program of the Gordon Research Conferences

The Gordon Research Conferences for 1960 will be held from 13 June to 2 September at Colby Junior College, New London, N.H.; New Hampton School, New Hampton, N.H.; and Kimball Union Academy, Meriden, N.H.

Purpose. The conferences were established to stimulate research in universities, research foundations, and industrial laboratories. This purpose is achieved by an informal type of meeting consisting of scheduled lectures and discussion groups. Sufficient time is available to stimulate informal discussions among the members of each conference. Meetings are held in the morning and in the evening, Monday through Friday, with the exception of Friday evening. The afternoons are available for recreation, reading, or participation in discussion groups, as the individual desires. This type of meeting is a valuable means of disseminating information and ideas to an extent that could not be achieved through the usual channels of publication and presentation at scientific meetings. In addition, scientists in related fields become acquainted, and valuable associations are formed that often result in collaboration and cooperative efforts between different laboratories.

It is hoped that each conference will extend the frontiers of science by fostering a free and informal exchange of ideas among persons actively interested in the subjects under discussion. The purpose of the program is to bring experts up to date on the latest developments, to analyze the significance of these developments, and to provoke suggestions concerning the underlying theories and profitable methods of approach for making progress, rather than to review the known fields of chemistry and physics.

In order to protect individual rights and to promote discussion, it is an established requirement of each conference that no information presented is to be used without specific authorization of the individual making the contribution, whether in formal presentation or in discussion. Scientific publications are not prepared as emanating from the conferences.

Registration and reservations. Attend-

ance at the conferences is by application. Individuals interested in attending the conferences are requested to send their applications to the director at least 2 months prior to the date of the conference. *All applications must be submitted on the standard application form, which may be obtained by writing to the office of the director.* This procedure is important because certain specific information is required in order that a fair and equitable decision on the application may be made. Attendance at each conference is limited to approximately 100 conferees.

The director will submit the names of those requesting authorization to attend to the Conference Committee for each conference. This committee will review the names and select the members in an effort to distribute the attendance as widely as possible among the various institutions and laboratories represented by the applications. A registration card will be mailed as soon as possible to those selected. Advance registration by mail for each conference is required, and registration is completed on receipt of the card and a deposit of \$15. (Checks are to be made payable to the Gordon Research Conferences.) The deposit of \$15 will be credited against the fixed fee for the conference if the individual attends the conference for which he has applied. A registration card not accompanied by the \$15 deposit will not be accepted.

The Board of Trustees of the conferences has established a fixed fee of \$100 for resident conferees at each conference. This fee was established to encourage attendance for the entire conference and to increase the special fund that is available to each conference chairman for the purpose of assisting conferees who attend a conference at total or partial personal expense to meet their travel or subsistence expenses or both. This fixed fee will be charged regardless of the time a conferee attends the conference—that is, for periods of from 1 to 4½ days. It is divided as follows: registration fee, \$40 (\$15 for administration and \$25 for the special fund); room and meals, \$60 (including gratuities) for 5 days. An additional charge of \$1 per night per person will

be made for a room with private bath or for a single room, of which there are only a limited number available. These rooms will be assigned in the order that applications are received. An additional charge will be made for rooms occupied more than 5 nights.

Members attending a conference are expected to live at the conference location because one of the objectives of the conferences is to provide a place where scientists can get together informally for discussion of scientific research of mutual interest. It is to the advantage of all participants to attend a conference for the entire week. When special circumstances warrant a request to live elsewhere, permission must be obtained from the director. If the request is approved, these nonresident conferees will be charged a registration fee of \$50.

The fixed fee will cover registration, room (except room with private bath or single room), meals, and gratuities for resident conferees. It will not provide for golf, telephone, taxi, laundry, conference photograph, or any other personal expenses.

Conferees living at the conference location who will pay all or part of the fixed fee as a personal expense may request a reduction of \$25 (the amount allotted for the special fund) in the fixed fee. Application for this special fee (\$75) must be made when the registration card is returned to the director.

Accommodations are available for wives who wish to accompany their husbands. All such requests should be made at the time the attendance application is submitted because these accommodations, limited in number, will be assigned in the order that specific requests are received. Children 12 years of age and over can be accommodated at the conferences. Pets are not permitted in the dormitories.

Special fund. A special fund is provided for by the Board of Trustees from the registration fee. It is made available to the chairman of each conference for the purpose of increasing the participation of research scientists who could not otherwise attend because of financial limitations. Its use is not limited to scientists who have been invited by the chairman to attend a conference in order to present research results. The money is to be used as an assistance fund only and may be used to contribute toward traveling expenses or subsistence expenses at the conference, or both. Total travel and subsistence expenses will not usually be provided.

Cancellations. The cancellation of an approved application for attendance at a conference will cause forfeiture of the \$15 deposit.

Attendance. Requests for attendance at the conferences, or for additional in-

formation, should be addressed to W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R.I. From 13 June to 2 September mail should be addressed to Colby Junior College, New London, N.H.

Colby Junior College

**Petroleum:
Friction, Lubrication, and Wear**
William A. Horne, *chairman*
Cheves Walling, *vice chairman*

13 June. Douglas Godfrey, "Boundary lubrication"; G. V. Vinogradov, "Fundamentals of extreme pressure lubrication."

14 June. George S. Reichenbach, "Friction and ball bearings"; J. M. Bailey, "Plastic and elastic deformations in single crystals."

15 June. R. L. Johnson, "Lubrication at extremely low and extremely high temperatures"; D. G. Flom, "Friction and lubrication of plastics."

16 June. B. G. Rightmire, "Hydrodynamics of lubrication"; R. J. S. Pigott, "Bearings, what are they."

17 June. John Boyd, "Electrostatic effects in lubrication."

Elastomers: Structure and Properties

R. L. Zapp, *chairman*
Gerard Kraus, *vice chairman*

20 June. F. P. Baldwin and I. Kuntz, "The chemistry of halogenated butyl-preparations and reactions"; P. J. Canterino and G. R. Kahle, "Chlorinated and chlorosulfonated polyolefins"; A. M. Bueche and D. G. Flom, "Rolling friction of elastomers."

21 June. R. W. Andrews, "Internal rotations of polymer molecules under mechanical stresses"; F. J. McGary, "Behavior of elastomers under rapid deformation"; M. Berger, subject to be announced.

22 June. I. Kuntz and Arthur Gerber, "The butyllithium initiated polymerization of 1, 3-butadiene"; C. G. Moore, "Present status of the chemistry of vulcanization of natural rubber"; K. E. Polmanteer, "Influence of organic side groups on the rheological properties of polysiloxanes."

23 June. G. Salomon, "Mechanism of ozone cracking"; A. R. Payne, subject to be announced.

24 June. J. F. Smith and G. T. Perkins, "The vulcanization of fluorocarbon elastomers"; René Chasset, "Electrical properties of vulcanizates."

Nuclear Chemistry

John O. Rasmussen, *chairman*
Ellis P. Steinberg, *vice chairman*
27 June. Beta decay—experimental and theoretical. Electron conversion line spectroscopy.

28 June. Radioactive decay scheme studies: P. Axel, "Nuclear isomerism—present-day systematics, selection rules, the Mössbauer scattering technique." Properties of nuclear energy levels in odd nuclei.

29 June. R. K. Sheline, "Energy level systematics and theory for even-even nuclei." Review of significant new developments in nuclear structure theory. W. J. Swiatecki, "New developments in liquid drop fission theory."

30 June. S. G. Thompson, "Spontaneous fission studies: angular and energy distributions of neutrons and evidence for triple fission"; A. C. Wahl, "Nuclear charge distribution in low energy fission"; L. D. Roberts, "Angular distribution of fission fragments from aligned nuclei."

1 July. L. Wilets, "Current status of fission theory."

Polymers

E. M. Fettes, *chairman*
L. A. Wall, *vice chairman*

4 July. H. Mark, "Recent advances in polymer chemistry"; C. G. Overberger, "New polymers and copolymers of α -olefins"; E. F. Cluff, "Relation of structure to properties in urethanes."

5 July. C. G. Moore, "Present status of the chemistry of vulcanization of natural rubber"; W. Scheele, "The kinetics of sulfur-decrease in accelerated and unaccelerated vulcanization of natural rubber and synthetic rubbers"; D. Craig, discussion leader.

6 July. I. M. Ward, "Transition phenomena in polyethylene terephthalate; infrared, x-ray and nuclear magnetic resonance studies"; K. Wolf, "Comparison of experimental results regarding the physical behavior of polyethylene"; F. H. Müller, "Calorimetric measurements with high polymers, especially the detection of irreversible reactions"; R. Buchdahl, discussion leader.

7 July. G. E. Ham, "Expansion of copolymerization theory (influence of neighboring units on radical reactivity with monomers)"; M. Morton, "Homogeneous anionic polymerization"; A. S. Hay, "Polymerization by oxidative coupling."

8 July. G. M. Burnett, "Some novel observations on polymerization in solution."

Textiles

Fred Fortess, *chairman*
H. J. White, *vice chairman*

11 July. A. B. Craig and J. P. Knudsen, "Acrylic fiber structure and properties as a function of coagulation system"; Ian Ward, "Molecular motion in polyethylene terephthalate and related polymers."

12 July. W. F. McDevitt, "Structure and properties of polyamide fibers"; H.

Zollinger, "The mechanism of dyeing polyamide fibers."

13 July. H. H. Summers, "The kinetics of dyeing cellulosic fibers with reactive dyes"; Z. A. Rogowin, "New methods of modification of cellulose fiber properties."

14 July. D. D. Gagliardi, "Different behavior of cotton, modified cotton and rayon in new crosslinking reactions"; Ludwig Rebenfeld, "Effect of cotton fiber structure on response to chemical treatments"; Verne W. Tripp and Rollin S. Orr, "Morphological differences in fine structure of cotton fibers."

15 July. C. E. Reese, "The relationship of fiber and fabric properties to wash and wear performance of poly fibers."

Corrosion

Milton Stern, *chairman*
Morris Cohen, *vice chairman*
Electrode Kinetics of Dissolution Processes

18 July. M. Cohen, *chairman*: L. H. Jenkins, "Observations on surface structures of copper single crystals undergoing aqueous dissolution"; M. Nagayama, "The nature of the passive film on iron in neutral solution"; F. A. Posey, "Potentiostatic and galvanostatic studies on passive stainless steel"; N. D. Greene, "Some recent studies of corrosion and passivity"; S. Barnartt, "Anodic reactions of stainless steels during stress corrosion cracking."

19 July. M. Stern, *chairman*: A. C. Makrides, "Cathodic processes in alkaline solution"; J. M. Kolotyrkin, "Influence of anions on the dissolution kinetics of metals"; G. H. Cartledge, "Effects of iodide ions and other inhibitors in the polarization of iron"; J. O'M. Bockris, "The mechanism of the dissolution of iron"; T. P. Hoar, "Dissolution kinetics of the iron group elements and their alloys—annealed strained and yielding."

20 July. J. F. Dewald, *chairman*: J. F. Dewald, "Analogies and distinctions between semiconductor and metal electrodes"; H. Gerischer, "Corrosion behavior of germanium as an example for semiconductor corrosion"; W. W. Harvey, "Chemisorption and semiconductor properties of germanium electrode surfaces"; W. Mehl, "The effect of hydrofluoric acid on the mechanism of anodic dissolution of germanium in sulphuric acid"; W. H. Brattain, "Observations on electrolytic processes at a germanium surface."

21 July. J. V. Petrocelli, *chairman*: H. Kaesche, "Mechanism of anodic pitting of aluminum"; C. Edeleanu, "Anodic polarization effects on aluminum"; L. Young, "Anodic oxide films on tantalum and zirconium"; N. D. Tomashou, "The corrosion and passivity of titanium"; J. B. Cotton, "Formation

and breakdown of anodic films on titanium."

22 July. C. Edeleanu, *chairman*: E. L. Koehler, "Application of electrochemical methods to the corrosion of can-making metals in food-acid media"; J. D. Sudbury, "Anodic passivation studies."

Separation and Purification

John E. Powers, *chairman*

Harry P. Gregor, *vice chairman*

25 July. Karl Kammermeyer, "Report on recent separation research in Europe"; Robert E. Anderson, "Separations with ion exchange resins. A broadening field"; F. O. Mixon and R. L. Pigford, "Boundary layer suction techniques applied to thermal diffusion."

26 July. I. A. Eldib, "Foam and emulsion fractionation"; M. Tayyabkhan and R. R. White, "Mass transfer and chemical reaction in beds of ion exchange resins"; H. Schildknecht, "New developments in zone melting including application to organic materials, micro-techniques, techniques at low temperatures, etc."

27 July. R. K. Finn, "Large scale electrophoresis"; G. H. Dale, "Development of continuous countercurrent crystall purification columns."

28 July. H. Schildknecht, "The crystallization column; a new device for fractional crystallization from the melt"; L. H. Tung, "Fractionation of high polymers"; H. G. Cassidy, "Electron exchange polymers: challenge to the development of new and novel separation and purification techniques."

29 July. Alexander Kolin, "Application of combined electric and magnetic fields to fractionation problems"; Arthur Karler, "Electrochromatography: a continuous processing system as applied to the full range of ionic to non-ionic feed stocks."

Instrumentation

Paul C. Hoell, *chairman*

J. M. Vandenberg, *vice chairman*

1-5 Aug. *Invited papers*: Jacob Rabnow, "Instrumentation and automation for the post office"; A. F. Sperry, "On-line analysis of chemical processes"; N. B. Nichols, "Impressions of Russian instrumentation"; Robert H. Kohr, "Application of computers to automobile ride and steering problems"; F. Gaynor Evans, "Instrumentation for stress-strain analysis of anatomical structures"; John L. Harned, "Dynamic power control through friction contacts"; Arthur Karler, "Continuous flow electrophoresis by curtain and cell type instrument."

Contributed papers: Malcolm D. Ross, "High altitude balloon research"; E. F. Corwin, "High altitude instrumentation"; L. J. Fogel, "Levels of in-

telligence in automata"; J. H. Laub, "Gas-lubricated spherical bearings"; Karl C. Kessler, "The use of atomic wavelengths for precision length measurements"; J. M. Vandenberg, "Absorbance measurements of perforated screens"; W. Wildhack, "Temperature measurement with a pneumatic gauge"; M. Irland, "An absolute reflectance attachment with variable angle of incidence"; Lloyd Slater, "Research proposals in instrumentation"; Enoch J. Durbin, "The calculation of obscure dynamic cause and effect relationships using analog computer techniques."

Food and Nutrition

David B. Hand, *chairman*

J. C. Bauernfeind, *vice chairman*

8 Aug. F. J. Butt, "The use of a chelating agent in food processing"; D. A. M. Mackay, "Characterization of flavors by gas chromatography"; R. Thiessen, Jr., "Radioactive tracers for screening new food additives for safety"; B. L. Oser, "The new regulatory control of food additives."

9 Aug. W. N. Pearson, "Correlation of biochemical measurements with other parameters of nutritional status"; I. C. Plough, "Correlation of clinical observations with nutritional status"; D. M. Hegsted, "Interpretive guides for nutritional appraisal"; Dorothy F. Hollingsworth, "Dietary survey techniques and interpretation."

10 Aug. A. E. Harper, "Amino acid imbalance"; J. B. Longenecker, "Amino acids in blood plasma as an indication of biological value proteins"; Milton Winitz, "Use of water-soluble, chemically defined diets in studies of non-essential amino acids and in vivo metabolic processes"; K. J. Carpenter, "Food technology and the availability of dietary amino acids."

11 Aug. R. E. Olson, "Evidence for the prevention of atherosclerosis in man by dietary means"; G. V. Mann, "Lack of evidence for the prevention of atherosclerosis in man by dietary means"; B. S. Platt, "Experimental production of severe protein malnutrition."

12 Aug. O. S. Privett, "Effect of processing on the property of dietary fats"; J. G. Coniglio, "Nutritional and metabolic effects of radiation."

Medicinal Chemistry

Irwin H. Slater, *chairman*

Cornelius K. Cain, *vice chairman*

15 Aug. Werner Kalow, "Effect of genetic variation on drug responsiveness"; D. K. de Jongh, "Factors influencing blood levels after oral administration of drugs"; George Karremann, "Electronic aspects of biological active compounds."

16 Aug. Andres Goth, "Relation of carbohydrate metabolism to inflamma-

tion"; V. W. Adamkiewicz, subject to be announced.

17 Aug. *Synthetic antibacterial agents*: Mary F. Paul, "Nitrofurans"; Earl H. Dearborn, "Sulfonamides." *Oleandomycin*: Francis A. Hochstein, "Chemical structure"; Walter D. Celmer, "Structure-activity correlations."

18 Aug. *Mescaline and related compounds*: Richard D. Morin, "Synthetic methods"; Leland C. Clark, Jr., "Pharmacology"; Irving H. Leopold, "The pharmacological struggle against ocular disease."

19 Aug. Paul Janssen, "Piperidine derivatives with analgesic and neuroleptic properties"; Arnold Friedman, "Pharmacological approaches to the treatment of headache."

Catalysis

Herman Pines, *chairman*

C. J. Plank, *vice chairman*

22 Aug. P. H. Emmett, "Report of the second International Congress in Catalysis"; R. E. Van Nordstrand, "X-ray absorption edges for the study of catalysts"; Myron L. Bender, "Homogeneous catalysis of the reactions of carboxylic acid derivatives."

23 Aug. S. Siegel, "Stereochemistry and the mechanism of hydrogenation of cyclo-olefins"; A. S. Hussey, "Stereochemistry and hydrogenation of cyclo-olefins. An insight to the mechanism"; P. Swietering, "The mechanism of the ammonia synthesis over iron catalysts."

24 Aug. R. J. Cvetanovic, "Catalytic reactions of butenes"; J. B. Peri, "Adsorption and reaction of butenes and other molecules on gamma-alumina"; J. E. Germain, "Reactions of some naphthenes on supported platinum catalysts."

25 Aug. C. D. Prater, "Kinetic studies of some heterogeneous catalytic reactions"; G. S. John, "Continuous flow stirred tank reactions: useful tool in studies of catalytic kinetics"; W. K. Hall, "Studies of the silica-alumina surface."

26 Aug. P. H. Lewis, "The effect of oxygen adsorption on the K x-ray absorption edge of alumina supported nickel."

Cancer

Philippe Shubik, *chairman*

Chester M. Southam, *vice chairman*

29 Aug. *Liver carcinogenesis*: Emmanuel Farber, "Studies with ethionine"; Peter Magee, "Experimental pathological and biochemical studies with dimethylnitrosamine"; John B. Cramer, J. A. Miller, E. Miller, "Studies on the N- and ring hydroxylation of 2-acetylaminofluorene"; Tore Hultin, "Metabolic effects of liver carcinogens and related agents in model experiments

of short duration"; J. D. Judah, "A general mechanism of liver injury."

30 Aug. Endocrine carcinogenesis: Howard A. Bern and Satyabrata Nandi, "The present status of the hormonal influence in mouse mammary tumorigenesis"; Thomas L. Dao, "Hormonal aspects of mammary carcinogenesis by 3-methylcholanthrene in rats"; Henri Isler, "Thyroid tumors with the normal cell populations of the thyroid." *Skin carcinogenesis:* R. K. Boutwell, "The development and use of mice bred for susceptibility and resistance to tumor induction"; Albert Tannenbaum, "Studies on skin carcinogenesis."

31 Aug. Viruses (Hilary Koprowski, chairman): Richard E. Shope, "Speculations concerning the mode of action of rabbit papilloma virus"; Leo Sachs, "Studies on the mechanisms of mammalian viral carcinogenesis"; Lloyd Law and Clyde Dawe, "Studies with parotid tumor virus"; M. J. Kopac, "Microsurgical studies on nucleoli of normal and malignant cells"; Michael Abercrombie, "Contact inhibition in tissue culture."

1 Sept. Metastasis (Chester M. Southam, chairman): Irving Zeidman, "The mechanics of the spread of cancer"; H. S. N. Greene, "The inhibitory influence of transplanted hamster lymphoma on metastasis"; Sumner Wood, "Role of vascular endothelium in tumor metastasis"; Renato Baserga, "Establishment and growth of tumor metastases, studied by the use of tritiated thymidine"; T. P. Morley, "The recovery of tumor cells from the blood in cases of cerebral glioma"; Warren H. Cole, "Clinical problems of tumor metastasis"; Bernard Fisher and Edwin Fisher, "Studies on hepatic metastasis"; Gabriel Gasic, "Cement substances in metastasizing and nonmetastasizing transplantable tumors in mice."

2 Sept. Rene Truhaut, "Evaluation of carcinogenic activity in food additives"; Robert E. Eckardt, "Occupational cancer."

Chemistry of Coal

John S. Mackay, chairman
Richard A. Glenn, vice chairman

13 June. The coking process—petrography and the coking mechanism: M. Schapiro; R. J. Gray; W. Spackman; W. Berry.

14 June. The coking process—new processes: Everett Gorin; Joseph Work; R. T. Joseph. *Carbon—physical structure:* J. A. Robertson; N. Rice.

15 June. Carbon—chemical structure: (speakers and subjects to be announced). *Carbon—structure and surface chemistry:* Jules V. Hallum.

16 June. Commercial carbons—special properties: (speakers and subjects to be announced). *Mineral constituents:* (speakers and subjects to be announced).

17 June. Summary—coal preparation: Richard A. Glenn. Programming the next conference.

Information Processing for Critical Tables of Scientific Data

Guy Waddington, chairman
Bruno J. Zwolinski, vice chairman

20 June. P. W. Bridgman, "Critique of critical tables"; F. D. Rossini, "The story of the *International Critical Tables*"; K. H. Hellwege, "Evolution of the Landolt-Börnstein Tabellen."

21 June. Guy Waddington, "The search for new patterns"; B. J. Zwolinski, "The operation of an integrated data project"; Carl F. Kayan, "Toward a simplification of our unit systems." Panel discussion: The symbolic language of science (panelists to be selected).

22 June. D. M. Newitt, "An engineer looks at scientific data"; J. P. McCullough, "From pre-research to finished tables"; E. J. Crane, "Problems of indexing and ordering."

23 June. Ray Pepinsky, "Literature imaging and property correlations"; J. Hilsenrath, "The role of the digital computer in preparing critical tables"; W. J. Youden, "The enduring values."

24 June. Discussion: Ideal project patterns (discussion leaders to be announced). Discussion: Needs and coordination (A. V. Astin, discussion leader).

Proteins and Nucleic Acids

Robert Sinsheimer, chairman
John Edsall, vice chairman

27 June–1 July. Enzyme synthesis during bacteriophage infection: S. Zimmerman; L. Pizer; J. Koerner; M. Bessman; R. Greenberg. *Biologically active nucleic acids:* H. Schuster; J. Marmur; D. Hogness; D. Kaiser. *DNA structure and synthesis:* L. Cavalieri; M. Meselson; J. Adler; F. Bollum; R. Smellie; G. Khorana. *RNA synthesis in vivo:* H. Harris; L. Goldstein. *Soluble RNA, ribosomes, and protein synthesis:* P. Berg; A. Tissieres; H. Dintzis; R. Holley; M. Stephenson. *Chemical mutation of DNA and RNA:* S. Benzer; E. Freese; I. Tessman; D. Krieg; G. Stent. *Correlation between genetic fine structure and protein structure:* W. Dreyer; C. Levinthal; S. Brenner. *Sequence studies in nucleic acids:* K. Burton; J. Josse; K. Reddi.

Chemistry and Physics of Isotopes

Ralph E. Weston, Jr., chairman
Arthur N. Bourns, vice chairman

4–8 July. Biochemical and biological aspects of deuterium isotope effects (J. J. Katz, chairman); J. J. Katz; D. Kritchevsky; H. L. Crespi. (Subjects to be announced.) *Isotope separation* (W.

Spindel, chairman); G. M. Begun and W. H. Fletcher, "Isotope separation factors in nitrogen systems"; A. A. Palko and J. S. Drury, "Isotope fractionation in BF_3 systems"; G. Zippe, "A simple short bowl centrifuge for U isotope separation"; S. V. Ribnikar and J. Bigeleisen, "Distillation of isotopic isomers"; G. R. Grove and W. J. Haubach, Jr., "Thermal diffusion studies." *Isotope effects on the equation of state of condensed phases* (J. Bigeleisen, chairman): T. F. Johns; D. White; E. N. Lassettre; S. G. Sydorik. (Subjects to be announced.) *Isotope abundance measurements in geochemistry* (T. C. Hoering, chairman): M. Williams, "Isotope abundances in carbonate rocks"; S. Epstein, "Oxygen isotopes in silicate rocks"; H. Thode, "Sulfur isotope geochemistry"; W. Eckelman, "Stable carbon isotopes in recent sediments"; B. Benson, "Isotopic analyses of nitrogen and oxygen in natural systems"; R. Jensen, "Sulfur isotopes in ore minerals"; T. C. Hoering, "Nitrogen and chlorine isotopes in nature. Carbon isotopes in photosynthesis." *Secondary hydrogen isotope effects* (E. S. Lewis, chairman): V. J. Shiner, Jr.; E. A. Halevi; A. Streitwieser, Jr. (Subjects to be announced.) *Kinetic isotope effects in reaction mechanism studies* (A. Fry, chairman): L. Melander, "Hydrogen isotope effects in electrophilic aromatic hydrogen exchange"; G. Ropp, "Isotope effects in reactions of formic acid"; F. Westheimer, "Investigations of the chemistry of phosphate esters with O^{18} "; P. Yankwich, "Isotope fractionation in C–O bond formation"; K. Wiberg, "Isotope effects in oxidation reactions"; E. M. Hodnett, "Isotope effects in polymerization reactions." Brief reports on work in progress (R. E. Weston, Jr., chairman): papers may be submitted at the beginning of the conference.

Statistics in Chemistry and Chemical Engineering

G. E. P. Box, chairman
Carl Bennett, vice chairman

11 July. Sigurd L. Andersen, "Economics of process and products development"; D. W. Behnken, "Some new designs at three levels."

12 July. Churchill Eisenhart, "Accuracy and precision"; Joseph V. Kelly, "Particle size distributions by extreme value theory."

13 July. Stanley Katz, "Time series and chemical process transfer functions"; Malcolm E. Turner, "Analysis of causal paths."

14 July. R. N. Curnow, R. J. De-Gray, J. S. Hunter, "Screening experiments"; J. Chamnugam, "Automatic optimization."

15 July. A. Baines, "Experiences in process development methods."

Radiation Chemistry

Max S. Matheson, *chairman*
John L. Magee, *vice chairman*

18 July. *The observation of intermediates in radiolysis* (F. P. Hutchinson, *chairman*): J. W. Boag, "U.V. absorption spectroscopy of irradiated liquids"; R. L. McCarthy and A. MacLachlan, "Transient species produced by high-energy electron radiation." *Special processes in radiation chemistry* (K. J. Laidler, *chairman*): H. J. Gomburg, "Resonances in radiation effects"; V. Cermak, "Ion molecule reactions in inorganic gases and gaseous mixtures."

19 July. *Radiation chemistry at low temperatures* (T. H. Anderson, *chairman*): J. M. Flournoy, "Some observations of the disappearance of trapped radicals in irradiated solids at low temperatures"; Russell Johnson, "Photolysis of free radicals produced by ionizing radiation." *Radiation-induced decomposition of crystalline solids* (Everett Johnson, *chairman*): J. Cunningham, "Mechanism of the γ -radiolysis of crystalline nitrates."

20 July. *Vacuum ultraviolet photochemistry* (F. F. Marmo, *chairman*): W. Groth, subject to be announced; B. Steiner, C. F. Giese, and M. G. Inghram, "The photoionization of molecules and the kinetics of their unimolecular dissociation." Open session for recent work.

21 July. *Behavior of electrons in condensed organic phases* (J. L. Magee, *chairman*): O. H. LeBlanc, Jr., "Electronic transport in organic solids and liquids"; R. S. Alger, "Electron properties in rigid organic compounds." *Effect of ionizing radiations on catalysts* (E. H. Taylor, *chairman*): M. Haissinsky, "Action of ionizing radiations on adsorption and catalysis."

22 July. *Radiation chemistry of aqueous systems* (A. O. Allen, *chairman*): C. Vermeil, "Radiation chemistry of aqueous solutions of benzoquinone and quinol"; H. Schwarz, "Absolute reaction rates of free radicals in water radiolysis."

Organic Reactions and Processes

William J. Bailey, *chairman*
Harold E. Zaugg, *chairman-elect*

25 July. W. Keith Langdon, "Preparation of heterocyclic amines by cycloamination"; John W. Lynn and Richard L. Roberts, "1,2,4-Butanetricarboxylic acid and derivatives"; Philip S. Skell, "The chemistry of divalent carbon."

26 July. Charles G. Overberger, "New reactions of 1,1-Di-substituted hydrocarbons"; N. B. Lorette, "The alkylation of ketones"; Robert F. Hudson, subject to be announced.

27 July. William C. Smith, "Fluorina-

Qualified scientists are invited to submit applications for attendance at the Gordon Research Conferences. Application blanks may be obtained by returning the coupon that appears on page 864 to Dr. W. George Parks, Department of Chemistry, University of Rhode Island, Kingston, R.I.

tion with sulfur tetrafluoride"; A. John Speziale and R. C. Freeman, "Synthesis and reactions of chloroenamines"; George Wittig, "Ylid reactions."

28 July. Harold Hart, "Chemistry of multicharged carbonium ions"; George B. Payne, "Oxidation and epoxidation with hydrogen peroxide and nitriles"; Melvin S. Newman, "Reactions of 2,5-cyclohexadienones containing trichloromethyl groups."

29 July. Calvin F. Stevens, "Epoxyethers."

Steroids and Other Natural Products

George Büchi, *chairman*

1-5 Aug. A. R. Battersby, "Researches on alkaloid biogenesis"; A. Brossi, "Total synthesis of an antibiotic"; E. J. Corey, "Recent work on terpenes"; T. G. Halsall, "Some researches in polyisoprenoid chemistry"; O. Jeger, "Some novel transformations of steroids"; J. Meinwald, subject to be announced; H. Muxfeldt, "Syntheses in the tetracycline series"; R. Pappo, "The chemistry of some 18-oxygenated steroids derived from conessine"; speaker to be announced, "Syntheses in the corticosteroid series"; H. Smith, "Some new total syntheses of oestrone and oestrone analogues"; G. Stork, subject to be announced; B. Witkop, "Chemical methods for the cleavage and modification of peptides and proteins"; R. B. Woodward, subject to be announced; H. Conroy, "The structure of echitamine."

Organic Coatings

S. Gusman, *chairman*

G. G. Schurr, *vice chairman*

8 Aug. C. A. Kumins, "Diffusion of gases and vapors through pigmented and unpigmented vinylfilms—glass transition effects"; E. G. Bobalek, "Inferences regarding polymer structure and properties from solubility studies."

9 Aug. J. Gaynor, "Fluidized bed coating"; Claus Victorius, "Organosol finishes from acrylic two-stage emulsion copolymers."

10 Aug. Raymond R. Myers, "The rheology of film curing"; J. C. Petropoulos, "Thermosetting acrylic coating resins."

11 Aug. John W. Swanson, "Some research problems in the coating of paper"; A. E. Rheineck, "The chemistry and technology of polyvinyl drying oil fatty acid esters."

12 Aug. W. H. Slabaugh, "Adsorption and pore volumes of unsupported organic films as related to filiform corrosion processes."

Analytical Chemistry

Charles N. Reilly, *chairman*
Sidney Siggia, *vice chairman*

15 Aug. Howard V. Malmstadt, "Transducers in analytical instrumentation"; Donald D. DeFord, "Computer amplifiers in analytical instrumentation."

16 Aug. F. W. McLafferty and Seymour Meyerson, "Determination of structures of organic compounds by mass spectrometry"; David Hume, "Flame photometry."

17 Aug. J. Howard Purnell, "Recent developments in the theory and practice of gas chromatography." Open discussion.

18 Aug. D. H. Wilkens, "Modern analysis of alloys by wet procedures"; Robert Kunin, "New developments in ion exchange materials of analytical interest."

19 Aug. Petr Zuman and Stanley Wawzonek, "Organic polarography."

Inorganic Chemistry

Charles P. Haber, *chairman*

Helmut M. Haendler, *vice chairman*

22-26 Aug. *Inorganic halogen chemistry* (Peter Girardot, *chairman*): Viktor Gutmann, "Ionic equilibria and coordination phenomena in halides and oxyhalides"; Alexander Popov, "Halogen charge-transfer complexes"; Milton Blander, "Interpretation of association constants in molten reciprocal salt systems"; Benson Sundheim, "Chloride melts." Light metal hydrides (T. R. P. Gibb, Jr., *chairman*): Anton B. Burg, "Some unsolved problems concerning the boron hydrides"; Robert W. Parry, "Werner's coordination theory and hydride chemistry"; William H. Klempner, "The structure of gaseous group I hydrides"; Olgierd J. Klejnot, "Some results in the hydride chemistry of boron and silicon"; Manley W. Mallett, "Light metal alloy hydrides"; William L. Jolly, "The volatile hydrides of group IV and V"; William M. Mueller, "Survey of light metal hydrides"; John O. Ruff, "Preparation and reactions of amine complexes of AlH_3 "; Thomas Wartik, "Some properties of solvated aluminum hydride." *Recent highlights*

**versatile
new
laboratory
recorder
only
\$295**



Major Features

- Single channel, 10 calibrated ranges with continuously variable adjustment between ranges:
- Calibrated volt and ampere ranges:

10 mv.	1 μ a.
0.1 v.	10 μ a.
1 v.	0.1 ma.
10 v.	1 ma.
100 v.	10 ma.
- 4 times chart width zero suppression in either direction.
- Chart speed of 1 in/hr and 15 in/hr. Eight optional speeds by a simple gear change.
- Pressure sensitive chart paper. No warm-up. Ready to record.
- Weighs only 11 pounds. Measures $9\frac{1}{2}$ " x $5\frac{1}{2}$ " x 7".

**Circle number below
on reader service
card for complete
specifications.**



YELLOW SPRINGS INSTRUMENT CO., INC.
YELLOW SPRINGS, OHIO

838

of inorganic chemistry in Europe; Hans Jonassen. *Phosphorus-nitrogen and phosphorus sulfur chemistry* (G. Barth-Wehrenalp, chairman): N. L. Pad-dock; R. Shaw; M. Becke-Goehring; T. Moeller; R. Raetz. (Subjects to be an-nounced.)

Adhesion

Harold F. Wakefield, chairman
Robert L. Patrick, vice chairman

29 Aug. J. J. Bikerman, "The science of adhesive joints"; F. J. Reil, "Degrada-tion of adhesive joints through heat or aging"; G. R. Irwin, "Mechanism of failure."

30 Aug. F. R. Eirich, "Adsorption of adhesives on surfaces"; W. T. M. John-son, "Adhesion and the chemical na-ture of surfaces."

31 Aug. H. E. Farnsworth, "Investi-gations with atomically clean surfaces"; C. A. May and A. C. Nixon, "Rela-tion between resin composition, physi-cal properties, and bond strength."

1 Sept. John W. Swanson, "Factors which affect adhesion of cellulose fibers." Open session on current prob-lems in adhesion research (John W. Rutzler, discussion leader).

2 Sept. D. V. Rosato, "Science of adhesion through ceramic and inor-ganic compounds."

Kimball Union Academy

Lipide Metabolism

Carleton R. Treadwell, chairman
Jules Hirsch, vice chairman

13 June. Cellular aspects of absorp-tion and uptake: Robert M. O'Neal, W. Stanley Hartroft, Wilber A. Thomas, "Electron microscopic studies of lipids in rats fed high-fat diets and single fatty meals"; John Glover, "Intestinal ab-sorption of lipids"; Cecil Entenman and Robert E. Kay, "The uptake, syn-thesis and release of lipids by the iso-lated perfused liver"; N. R. Diluzio, "Hepatic cell participation in lipid metabolism."

14 June. *Lipide metabolism*: Edward J. Masoro, "A study of the regulation of lipid metabolism by experimentally varying the nutrition and environment of a mammal"; Daniel Steinberg and Martha Vaughan, "Adipose tissue metabolism and its control by hor-mones"; W. L. Gaby, Thor Zajac, Ron-ald Silberman, "The role of phospho-lipids in metabolism." *Sterol metabo-lism*: R. G. Langdon, "Branched chain acids in biosynthesis of cholesterol"; George Popjak, "The intermediary stages of sterol biosynthesis in the liver."

15 June. *Sterol metabolism*: Peter D. Klein, "Studies on the metabolism of cholesterol esters"; James L. Gaylor, " Δ^7 -cholesterol and related compounds in skin"; R. B. Clayton and Konrad

Bloch, "The utilization of sterols in in-sects." *Sterols and bile acids*: Paul F. Smith, "Uptake and utilization of sterols by pleuropneumonia-like organisms"; James G. Hamilton, "Quantitative and qualitative determination of bile acids by glass paper chromatography."

16 June. *Bile acids*: Ezra Staple, "The conversion of cholesterol to bile acids: in vitro studies"; S. Bergstrom, "The conversion of cholesterol to bile acids: stereochemical and quantitative as-pects"; Liese L. Abell, "Hormonal fac-tors in the metabolism of sterols to bile acids"; S. L. Hsia and John T. Matschiner, "Isolation and identifica-tion of new metabolites of bile acids"; Robert B. Failey, Jr., "Some aspects of bile acid metabolism in man."

17 June. *Complex lipids*: H. E. Car-ter, "Chemistry of cerebrosides and other glycolipids"; Andrew A. Benson, "Lipid structure and metabolism in photosynthetic tissues"; L. P. Zill and E. A. Harmon, "Biochemical studies of plant lipids."

Cell Structure and Metabolism

S. L. Palay, chairman
G. E. Palade, vice chairman

20 June. *Synthesis of secretory products, especially enzymes and pro-teins as exemplified in the pancreas* (G. C. Hirsch, chairman): G. E. Palade; P. Keller; L. E. Hokin; L. C. U. Junqueira; H. Sheldon.

21 June. *Synthesis of secretory prod-ucts in liver and other glands*: T. Peters; R. W. Hendler; E. Kuff; W. Bargmann.

22 June. *Secretion of ions and water* (R. E. Davies, chairman): A. Seder; W. S. Rehm; R. D. Wright; G. D. Pappas.

23 June. *Endocrine glands* (E. Schar-er, chairman): S. L. Wissig; S. Woll-man, C. P. Leblond; J. Roche, W. H. McShan.

24 June. *Secretion by mucoprotein-producing glands*: D. W. Fawcett; S. L. Palay; Sir Howard Florey.

Additional speakers and discussions to be announced.

Physical Metallurgy

R. L. Fullman, chairman
Michael Bever, vice chairman

27 June-1 July. R. D. Seraphim, "Effect of impurities and defects in superconductors"; A. W. Overhauser, "Theory of resistance minimum in di-lute paramagnetic alloys"; W. B. Pear-son, "Interpretation of relative thermo-electric phenomena in pure metals and dilute alloys at low temperatures"; P. A. Flynn, "Deformation of solid solutions"; D. A. Thomas, "Influence of grain size on deformation"; J. Kruger, "Relation-ship between surface orientation and film formation in aqueous solutions"; F. W. Young, "Mechanism of disloca-tion etch pitting"; D. A. Vermilyea,

Pseudotsuga menziesii meets the Instron



This is a single fiber derived from the wood of a Douglas fir.
Latin name: *Pseudotsuga menziesii*. Dimensions: spectacularly minute.
Length: 0.165". Cross-section area: 0.318×10^{-6} sq. in. It makes a common straight pin look like a flag pole in comparison.

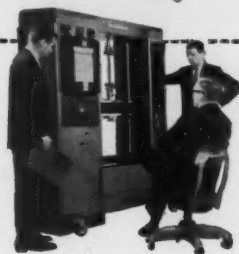
Yet, from this frail specimen and others like it, the Instron Testing Instrument has been able to extract a mountain of data — including tensile strength, proportional limit stress, Young's modulus, work to failure, and deformation at failure.

Such data, of extreme usefulness to papermaking researchers, has never been collected before. Which shows what we mean when we say, "you can do more with an Instron".

For the complete story of this test, currently being continued at Washington State University, ask for Bulletin WO-1. If you've other problems in mind, chances are we have something that will interest you. Among the articles on advanced testing techniques that are yours for the asking: testing tungsten at high temperature . . . stress-strain properties of textile fibers . . . physical properties of plastics and elastomers . . . characterization of, pressure-sensitive adhesives.

Let us know your field of interest.

INSTRON
a new dimension
in precision
materials testing



INSTRON®
ENGINEERING CORPORATION
2513 WASHINGTON STREET, CANTON, MASS.

EUROPEAN OFFICE: SEEFELDSSTRASSE 45, ZURICH, SWITZERLAND

YOU CAN DO MORE WITH AN INSTRON

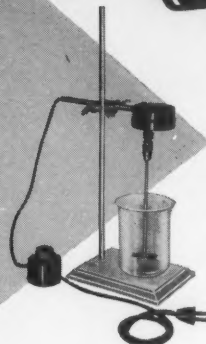
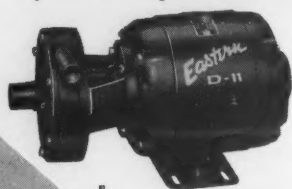
The unusual versatility of this fine testing instrument is greatly extended by Instron's complete range of special accessories, which can be added as you need them. They include: XY recorder for extensometers • automatic digital readout • environmental cabinets • quick-change crosshead-speed selector • variable speed drive • high temperature equipment • load pacing • automatic cycling controls. Write for the complete Instron catalog.

Eastern "job-sized" pumps and stirrers save weight • space • power • costs

Eastern has just the right pumps or mixer for your laboratory or pilot plant application. The wide range of Eastern products lets you choose standard units so closely geared to the job that they might have been created just for it.

A complete engineering service to help you, and a big selection of more compact, versatile, high performance pumps and stirrers — this is the formula for your quick and easy choice.

Send for laboratory equipment bulletin No. 1540



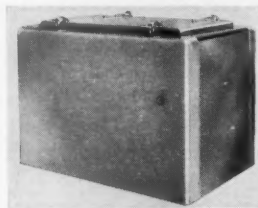
A wide range . . . in **midget pumps:** centrifugal and positive pressure models—motors from 1/30 to 1/3 hp, capacities to 20 gph, pressures to 60 psi.

in **variable speed stirrers:** From 1/100 to 1/15 hp non-sparking motor with clamp or ring stand just right for your lab use.

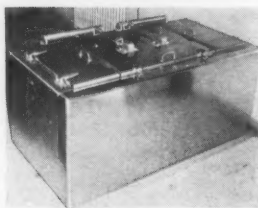
EASTERN INDUSTRIES, INC.

100 SKIFF STREET • HAMDEN 14, CONNECTICUT

For Sub-Zero Storage The CSI Dry Ice Storage Cabinet



MODEL GS-34



SPECIAL

All cabinets are manufactured of welded and polished stainless steel which contributes to cleanliness, appearance and serviceability. Efficiency has been accounted for in such features as high quality insulation, interchangeable storage inserts and size. The width allows passage through a normal door and the length is the only dimension changed in the three sizes. The cabinets are built with or without the CO₂ entering the storage compartment. The cabinet on the left is our standard model and the unit on the right is specially constructed to the customer's design.

Folder and Prices Upon Request

CUSTOM SCIENTIFIC INSTRUMENTS, INC.

541 Devon St.

Kearny, N.J.

"Electrodeposition and defect structure"; J. E. Dorn, "Shock loading"; J. W. Nutting, "Dispersions and creep"; W. W. Smeltzer, "Oxidation characteristics of zirconium, titanium and hafnium"; B. Wagner, "Oxidation of metals in carbon monoxide-dioxide mixtures"; W. A. Backofen, "Ductile fracture"; T. L. Johnston, "Brittle fracture"; D. O. Smith, "Anisotropy of thin magnetic films"; D. S. Rodbell, "Ferromagnetic resonance studies of whiskers and particles"; S. Chikazumi, "Roll magnetic anisotropy"; E. A. Nesbitt, "Magnetic annealing in the permalloys and perm-invars"; A. Arrott, "Ferromagnetism and antiferromagnetism in alloys"; C. A. Neugebauer, "Some properties of evaporated metal films"; A. J. Forty, "Corrosion cracking."

Chemistry at Interfaces

Herman E. Ries, Jr., *chairman*
Ralph A. Beebe, *vice chairman*

4 July. *Thermodynamics of interfaces* (L. E. Copeland, *chairman*): T. F. Young, "Thermodynamics of surfaces of electrolytic solutions"; L. Ter Minasian-Saraga, "Ionized monolayers and their free electrical energy"; A. V. Kiselev, "The energy of adsorbate-adsorbent and adsorbate-adsorbate interactions in monolayers on solid surfaces."

5 July. *Dispersed systems* (H. van Olphen, *chairman*): Robert Ullman, "Light scattering methods in the investigation of surface structure"; C. T. O'Konski, "Electrical properties of dispersed systems"; J. T. G. Overbeek, "The influence of the relaxation effect in electrophoresis and other electrokinetic phenomena."

6 July. *Monolayers* (H. J. Trurnit, *chairman*): F. M. Fowkes, "Monolayers as two-dimensional solutions"; G. L. Gaines, Jr., "Some cooperative interactions in monolayers"; N. K. Adam, "Developments in monolayer research."

7 July. *Monolayers* (F. H. Healey, *chairman*): G. E. Boyd, "Theories of the liquid expanded state in monolayers: an experimental study"; Ira Blei, "A study of protein-detergent interaction by monolayer penetration"; Paul Becher, "The effect of surface active agents on the properties of the oil-water interface"; B. V. Derjaguin, "The mechanism of the controlling role of monolayers on the kinetics of some processes in heterogeneous systems."

8 July. Related topics and general discussion.

Chemistry, Physiology, and Structure of Bones and Teeth

B. B. Migicovsky, *chairman*
W. P. Norris, *vice chairman*

11 July. *Selected communications* (Clayton Rich, *chairman*): W. P. L. Myers and W. Lawrence, Jr., "Studies

on the influence of cortisone on serum calcium homeostasis"; C. A. L. Bassett, "Factors contributing to osteogenesis in vitro"; T. W. Speckman and W. P. Norris, "Variations in retention kinetics of bone seeking isotopes"; J. Samachson and H. Spencer, "Comparison of single and multiple doses of Sr^{85} and Ca^{45} in man"; J. M. Janes, P. J. Kelly, L. F. A. Peterson, "The effect of beryllium on bone, a morphologic study of the progressive changes in rabbit bone." *Bone induction* (Leroy Lavine, chairman): J. S. Nicholas, "Induction and its relationship to bone structure"; M. Moss, "Osteogenic induction factors."

12 July. *Bone induction (continued)* Leroy Lavine, chairman: J. J. Pritchard, "Recruitment of osteoblasts relating to bone induction"; Hans Selye, "Induction of bone by tissue scaffoldings." *Nature and mechanism of hard tissue destruction* (Reidar F. Sognnaes, chairman): N. M. Hancox, "The osteoclast."

13 July. *Nature and mechanism of hard tissue destruction (continued)* (Reidar F. Sognnaes, chairman): Charles M. Dowse and William Neuman, "Metabolism of bone cells"; George Nichols, Jr., Nancy Nichols, André B. Borle, Stein Schartum, Gilbert Vaes, "Cellular metabolism of bone"; Paul Goldhaber, "Further observations on experimental bone resorption in tissue culture." *Organic matrix in calcification* (M. J. Glimcher, chairman): F. Pautard, "The nature of the organic matrix and its role in the development of calcified structures."

14 July. *Organic matrix in calcification (continued)* (M. J. Glimcher, chairman): L. Johnson, "Histochemical changes in organic matrix accompanying calcification"; A. Sobel, "Role of the organic matrix in the nucleation and growth of bone crystals." *Calcium metabolism* (F. McLean, chairman): J. Vincent, "Metabolic bone at the histological level."

15 July. *Calcium metabolism (continued)* (H. F. Deluca, chairman): A. M. Shanes, "Movement of calcium in non-skeletal tissues"; M. R. Urist, "Calcium and protein relations in the blood"; R. H. Wasserman, "Passage of calcium across biological membranes."

High Pressure Research

H. G. Drickamer, chairman
O. L. Anderson, vice chairman

18 July. R. H. Wentorf, Jr., chairman: H. T. Hall and F. P. Bundy, "The synthesis of diamond." W. H. Jones, chairman: I. S. Bengelsdorf, "Behavior of organic compounds at high temperature and pressure"; I. B. Johns, "Organic reactions at high pressure."

19 July. J. M. Nielsen, chairman: R. Laudise and R. Roy, "Hydrothermal and related syntheses"; U. O. Hutton,

Positive stop readings in 1.13 seconds

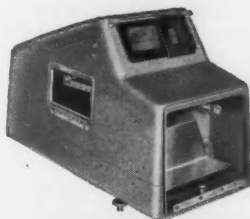
MODEL
4203B-TC-SA



SHADOGRAPH®

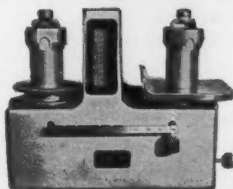
small animal balance provides
visible accuracy to 350 milligrams

Model 4203B-TC-SA Shadograph is designed especially for high-speed, precision weighing of mice, chicks, frogs and small rats. It can reduce tedious weighing operations by hours . . . give you more time for other work. Light-projection indication is fast . . . provides sharp shadow-edge reading on frosted glass dial. Parallax reading eliminated. Capacity 1500 grams. Dial graduated in two columns: 0-30 grams and 15-45 grams. Shutter closes dial column not in use. Beam 100 grams in 1 gram graduations. Weighs accurately in out-of-level positions. Other models up to 3 kilos for rats, hamsters and guinea pigs.



TISSUE AND TUMOR BALANCE

Model 4142 recommended for fast, precision weighing of cancer tissue and tumors. Weighpan is shielded from air currents by clear plastic door . . . easily removed for sterilization. Rated capacity 15 grams; visible sensitivity to 5 milligrams. Movable viewer for 5-column dial, each column 3 grams with 5 milligram graduations. 5-notch beam corresponding to dial columns.



CENTRIFUGE BALANCE

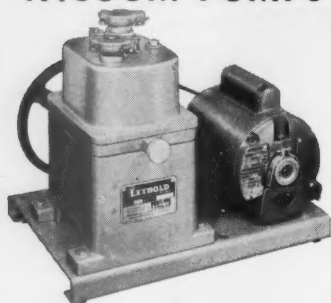
Model 4206B-TC also for general laboratory use and small-animal weighing. Has tare control knob to zero the dial, or position for over-and-under reading. Capacity 3 kilos; sensitivity to 350 milligrams. Dial is graduated 0-100 grams in increments of 1 gram. Beam 500 grams by 5 grams.

THE EXACT WEIGHT SCALE CO.
901 W. FIFTH AVE., COLUMBUS 8, OHIO
In Canada: 5 Six Points Road, Toronto 18, Ont.

Sales and Service Coast to Coast



LEYBOLD Gas Ballast VACUUM PUMPS



World Famous Quality, Design and Dependability

The Leybold Gas ballast design actually prevents condensation of vapor in the pump. It prevents oil contamination from lowering ultimate pressures, cuts oil changes and pump maintenance.

Leybold Pumps can be operated with or without gas ballast, so that you get the advantages of both gas ballast and oil sealed rotary vane pumps.

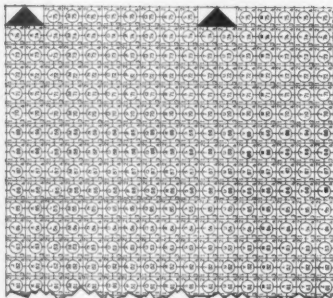
WRITE FOR NEW
BULLETIN TODAY!



ARTHUR S. LAPINE and COMPANY
6001 South Knox Avenue, Chicago 29, Illinois
LABORATORY SUPPLIES AND REAGENTS

ATTENTION MICROSCOPISTS

Here is the England Finder for relocating
points of interest on any microscope.



Easily cleaned as heat or chemicals don't
harm it.

ERIC SOBOTKA CO. •

108 West 40th St.

New York 18, N. Y.

Specialists in Imported Equipment

D. T. Griggs, A. A. Giardini, "New high pressure techniques and experiments."

20 July. F. B. Bundy, *chairman*: H. M. Strong, L. Coes, F. Birch, "Phase transitions at high pressure." John Jamieson, *chairman*: D. T. Griggs, "Geophysical research at the University of California at Los Angeles"; H. Greenwood, "Recent work on compressed gases."

21 July. D. W. McCall, "NMR studies at high pressure"; W. M. Walsh, Jr., "High pressure resonance work at Harvard." H. G. Drickamer, *chairman*: G. W. Johnson and R. E. Batzel, "The physical and chemical effects of underground nuclear explosions."

22 July. A. van Falkenburg, J. Jamieson, H. G. Drickamer, "Recent high pressure developments."

Chemistry and Metallurgy of Semiconductors

A. J. Rosenberg, *chairman*

25 July. *Crystal growth*: P. Egli, "Zone concept of crystal growth"; D. A. Vermilyea, "Defect mechanism of crystal growth"; R. L. Longini, "Dendritic crystal growth"; F. H. Horn, "High temperature crystal growth."

26 July. *Impurity phenomena*: H. J. Vink, "Non-stoichiometry in semiconductors"; H. Reiss, "Interaction of chemical and lattice defects"; K. Weiser, "Theory of solubility of impurities"; J. B. Mullin, "Anisotropic segregation."

27 July. *Surface chemistry*: C. G. B. Garrett, "Continuum approach to surface reactivity"; H. C. Gatos, "Atomic approach to surface reactivity"; G. Parravano, "Catalytic activity of semiconductor surfaces"; W. W. Harvey, "The semiconductor electrode."

28 July. *Chemical bonding in semiconductors*: W. B. Pearson, "Valence bond approach"; J. B. Goodenough, "Crystal field approach"; A. R. Von Hippel, "The future of molecular engineering."

29 July. *Correlation of physico-chemical and electronic properties*: O. G. Folberth, "Influence of bond type on electronic properties"; J. B. Conn, "Influence of structure on electronic properties."

Solid-State Studies in Ceramics

J. H. Westbrook, *chairman*
Larry Himmel, *vice chairman*

Microstructural Studies in Ceramics

1 Aug. *Geometry*: J. E. Hilliard, "New results in quantitative petrography"; J. C. Griffiths, "Definition of micro and macro scale aggregates."

2 Aug. *Techniques*: H. Pfisterer, "Comparative ceramographic and electron fractographic techniques"; J. J.

Comer, "Methods for studying microstructure with the electron microscope"; G. A. Wolff, "Optical studies of microcleavage, bond character, and surface structure in crystalline materials."

3 Aug. *Origins*: L. H. Van Vlack, "Interfacial energy versus composition of non-metallic phases"; I. I. Kitai-gorodskii, "Crystallization and grain growth in glass and ceramic systems." *Structure versus properties*: J. Gurland, "Relationships between microstructure and mechanical properties"; C. Kooy, "Relationships between microstructure and magnetic properties."

4 Aug. *Structure versus properties (continued)*: D. A. Lupfer, "Effects of macrostructure and microstructure on dielectric properties"; R. C. DeVries, "Morphology of ferroelectric domains in BaTiO₃ crystals." C. S. Beals, "Meteorites and meteorite craters on the earth and moon."

5 Aug. *Structure versus properties (continued)*: C. P. K. Chu, "Microstructural studies on coatings"; F. Ordway, "Relations between properties and structure in cement and concrete."

Chemistry and Physics of Solids: Point Defects

Robert L. Sproull, *chairman*
Robert Maddin, *vice chairman*

8 Aug. J. M. Whelan, "Interactions of holes, electrons, and electrically active impurities in GaAs"; E. M. Pell, "Lithium impurity interactions in silicon"; H. Brooks, "Key problems in the theory of point defects"; G. H. Vineyard, "Information on point defects from radiation damage."

9 Aug. D. Wilsdorf, "Interaction of point defects and dislocations"; M. J. Makin, "Point defects and mechanical properties of metals"; R. W. Balluffi, "Measurements of equilibrium point defect concentrations"; T. Federighi, "The role of point defects in clustering in supersaturated aluminum alloys."

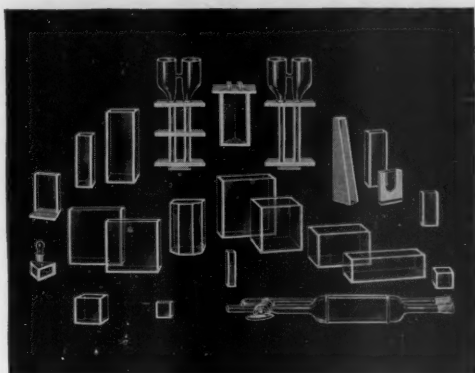
10 Aug. R. M. Walker, "Radiation damage and point defects in metals"; J. S. Koehler, "The nature of point defects in metals"; H. S. Sack, "Review of dielectric relaxation and internal friction." Round table discussion: R. W. Dreyfus, D. O. Thompson, B. S. Berry, and C. A. Wert.

11 Aug. G. D. Watkins, "Study of defects by electron spin resonance"; C. P. Slichter, "Applications of nuclear magnetic resonance"; W. D. Compton, "Optical studies of point defects in insulators"; S. Zwerdling, "Zeeman effect of impurity excited states in semiconductors."

12 Aug. J. H. Crawford, Jr., "Defect formation in ionic crystals by ionizing radiation."

GLASS ABSORPTION CELLS

made by **KLETT**

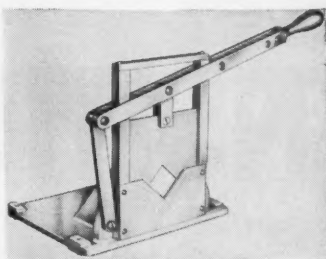


SCIENTIFIC APPARATUS
Klett-Summerson Photoelectric Colorimeters—
Colorimeters—Nephelometers—Fluorimeters—
Bio-Colorimeters—Comparators—Glass Stand-
ards—Klett Reagents.

Klett Manufacturing Co.
179 East 87 Street, New York, New York

DECAPITATOR

Catalog no. 130-RM



A simple, rugged device for the instant decapitation of small laboratory animals. Maximum opening is $1\frac{1}{4}$ ".

FEATURES

- Stainless steel blades and fittings
- Self sharpening blades
- Cast aluminum base
- Easily disassembled
- Can be totally immersed for cleaning
- Can be permanently mounted on bench

\$47.00—f.o.b. Dover, Mass.

Also available for laboratory use are:

Tissue Press (Catalog number 141) \$75.00

Tissue Slicer (Catalog number 140) \$48.50

Please write for Data Sheet T-140

Catalog 1960 available on request

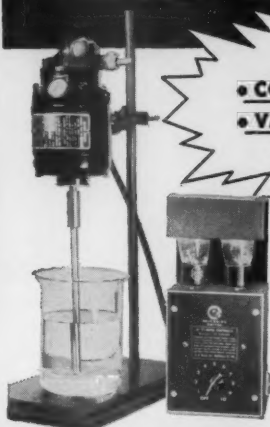


HARVARD APPARATUS CO., INC.

DOVER • MASSACHUSETTS • U.S.A.

(a non-profit organization)

HELLER ELECTRONIC CONTROLLED LAB MIXER



Complete with
attachments
F.O.B. Las Vegas

\$90

PROVIDES:

- **CONSTANT TORQUE**
- **VARIABLE DC SPEEDS FROM AC LINES**

• Thyatron tubes on the Heller GT-21 controller supply demanded current by converting power in stepless variation to the direct current motor. Assures constant torque as mixes become either viscous or fluid. Variable, reversible motor has direct and gear drive. Armature shaft speed, 0-5000 rpm. Gear shaft 18:1 ratio. Chuck, shafts, 3-step pulley included.

Order from your Laboratory Supply Dealer or write—

GERALD K. HELLER CO.
1819 Industrial Road Las Vegas, Nevada

NEW PRICES—NEW PRODUCTS

IN WINTHROP'S 1960 PRICE LIST OVER 100 BULK CHEMICALS

INCLUDING

- PHARMACEUTICALS such as
DIPYRONE, PHENYLEPHRINE
- PYRAZOLONES such as
PHENYL CARBETHOXY
PYRAZOLONE,
PHENYL METHYL
PYRAZOLONE
- INTERMEDIATES such as
DIPHENYLACETONITRILE,
MALONONITRILE
- AMINO ACIDS and other
BIOCHEMICALS

MANY PURCHASING AGENTS, PRODUCTION MANAGERS AND RESEARCH DIRECTORS HAVE BEEN AMAZED AT THE WEALTH OF CHEMICAL STOCKS AVAILABLE FROM WINTHROP

If you want something Special BE PREPARED

FILL OUT THE COUPON FOR PROMPT MAILING.

Winthrop Laboratories Dept. S-3-18-0
Special Chemicals Dept.
1450 Broadway, New York 18, N. Y.

Name.....

Firm.....

Street Address.....

City..... Zone..... State.....

CAMBRIDGE GAMMA-RAY POCKET DOSIMETER

This personnel monitoring instrument measures the cumulative exposure to gamma or x-rays over a given period of time. The instrument consists of an ionization chamber, a quartz fibre electrometer and a graduated scale and viewing system.



The charging unit comprises a 180 volt "B" battery, a 1½ volt "A" battery, a flashlight bulb, the well for inserting Dosimeter, and the charging control.



SEND FOR BULLETIN 300 G.D.

Cambridge also makes the Lindemann-Ryerson Electrometer, with power rectifier and portable projection viewer.

CAMBRIDGE INSTRUMENT CO., INC.

3556 Grand Central Terminal, New York 17, N.Y.

Pioneer Manufacturers of Precision Instruments

Just Published: Volume 22 (March, 1960)

ANNUAL REVIEW OF PHYSIOLOGY

Editors: V. E. Hall, F. A. Fuhrman and
A. C. Giese

Contents:

Prefatory Chapter
Nuclear Function and Nuclear Cytoplasmic Interactions
Developmental Physiology
Aspects of Genetics
Kidney, Water and Electrolyte Metabolism
Respiration
Digestion
Blood Volume Regulation
Peripheral Circulation
Heart
Conduction and Transmission in the Nervous System
Somatic Functions of the Nervous System
Visceral Functions of the Nervous System
Higher Functions of the Nervous System
Vision
Adenohypophysis and Adrenal Cortex
Thyroid Gland
Reproduction
Comparative Physiology: Fuel of Muscle Metabolism
Comparative Physiology: Respiratory Pigments in Marine Invertebrates

\$7.00 postpaid (U.S.A.); \$7.50 postpaid (elsewhere)

ANNUAL REVIEWS, INC.

Grant Avenue, Palo Alto, California



unequalled for

SENSITIVITY

The most precise instrument for all
fluorometric methods of analysis . . .
for research and routine procedures.
Provides precise, reliable measurements
over a wide range of sensitivities.
Ideal for extremely low concentrations
in micro or macro volumes.

Farrand Photo-Electric

FLUOROMETER

Bulletin No. 803S
sent on request

FARRAND OPTICAL CO., INC.

BRONX BLVD. AND EAST 238th STREET • NEW YORK 70, N. Y.

Engineering, Research, Development, Design and Manufacture of Precision Optics, Electronic and Scientific Instruments

Toxicology and Safety Evaluations

David W. Fassett, *chairman*
Frank R. Blood, *vice chairman*

15 Aug. B. J. Vos, "The interpretation of carcinogenesis experiments"; R. M. Mulligan, "Comparative pathology of human and canine tumors"; John McGrath, "Neurologic diseases of the dog."

16 Aug. Elliott Maynard, "Use of behavioral techniques in a study of heavy metal poisoning"; Thom Verhave, "The analysis of behavioral patterns in experimental animals"; Charles B. Ferster, "Some applications of behavioral analysis"; J. Teisinger, "Application of Pavlov techniques to toxicology."

17 Aug. *Problems in the toxicologic evaluation of new drugs—evaluation in animals* (Fred Coulston, *chairman*): Kenneth Dubois and John Litchfield, "Evaluation in animals." *Problems in the toxicologic evaluation of new drugs—evaluation in humans* (Sidney Farber, *chairman*): Ralph Jones, K. G. Kohlstaedt, Ralph Smith, "Evaluations in humans."

18 Aug. J. Teisinger, "Significance of biological tests for exposure in industrial toxicology"; T. Clarkson, "Biochemical aspects of heavy metal poisoning"; J. Radomski, "Influence of environmental temperature on toxicologic reactions." Henry Hurtig, *chairman*: Simone Dormal, "Experiences with pesticide residue problems in Europe."

19 Aug. Lewis Schanker, "Absorption of foreign organic compounds from the gut"; K. C. Huang, "Excretion of chemical compounds by the kidney."

Infrared Spectroscopy

D. A. Ramsay, *chairman*

M. K. Wilson, *vice chairman*

22 Aug. G. C. Pimentel, *chairman*: L. Couture-Mathieu, "Infrared and Raman spectra in crystals"; J. Fahrenfort, "Infrared reflection spectra"; H. J. Hrostowski, "Electronic absorption of bizarre impurities in silicon and germanium in the infrared region."

23 Aug. B. Crawford, Jr., *chairman*: P. Jaquinot, "Recent advances in the near infrared"; L. Grenzel, "Recent advances in the far infrared"; speaker to be announced, "Recent infrared investigations in Russia."

24 Aug. R. R. Brattain, *chairman*: A. D. Buckingham, "Theory of solvent effects in infrared spectra"; W. B. Person, "Infrared intensities"; A. C. Jones, "Measurement of real Raman intensities."

25 Aug. M. K. Wilson, *chairman*; M. A. Eliashevich, "Molecular vibrations"; J. Overend, "Molecular force fields"; L. J. Bellamy, "Infrared spectra of large molecules."

26 Aug. W. J. Potts, *chairman*: W. Klemperer, "High temperature studies in the infrared"; C. H. Townes, "Progress report on the status of infrared masers."

High-Temperature Chemistry: Kinetics of Vaporization and Condensation Processes

Leo Brewer, *chairman*

Paul W. Gilles, *vice chairman*

29 and 30 Aug. *Effusion studies*: Robert J. Thorn; R. S. Bradley; Thomas E. Phipps; George W. Winslow; K. Douglas Carlson.

30 Aug. *Transpiration studies*: U. Merten.

31 Aug. *Crystal growth and condensation coefficients*: G. W. Sears and J. P. Hirth.

1 and 2 Sept. *Mass spectroscopy and field emission microscopy*: W. A. Chupka; John McKinley; Paul Schissel; Robert Comer.

Forthcoming Events

April

7-9. Optical Soc. of America, Washington, D.C. (K. S. Gibson, OSA, Natl. Bureau of Standards, Washington 25.)

8-9. American Assoc. of University Professors, Detroit, Mich. (P. R. David, Univ. of Oklahoma, Norman.)

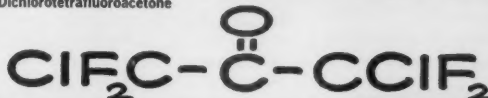
8-9. New Mexico Acad. of Science, Socorro. (K. G. Melgaard, P.O. Box 546, University Park, N.M.)

8-9. Southern Soc. for Philosophy and Psychology, Biloxi, Miss. (E. Henderson, Florida State Univ. Tallahassee.)

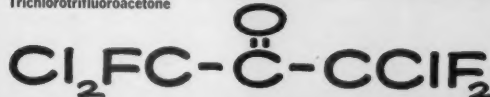
8-11. American Dermatological Assoc., Boca Raton, Fla. (W. M. Sams, 308 Ingraham Bldg., Miami 32, Fla.)

9-10. Histochemical Soc., 11th annual,

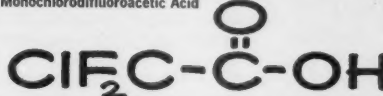
Dichlorotetrafluoroacetone



Trichlorotrifluoroacetone



Monochlorodifluoroacetic Acid



Now ready for your investigation...

THREE HIGHLY REACTIVE FLUORO ORGANICS

from the research laboratories of General Chemical, leader in fluorine chemistry

In its investigations of fluorine-containing acetones, General Chemical has developed and now offers experimental quantities of two promising ketones and a powerful acid:

1. Dichlorotetrafluoroacetone
2. Trichlorotrifluoroacetone
3. Monochlorodifluoroacetic acid

These fluoro organics have demonstrated unusual reactive capabilities which suggest a variety of possible applications including use as complexing agents, catalysts, and raw materials for fluoro-organic synthesis.

The ketones can be hydrated, alcoholated and ammoniated. They are stable in acid but react with alkalis to form derivatives of monochlorodifluoroacetic acid. They form amine and urea com-

plexes and show interesting pyrolytic reactions.

As a starting point for your own investigations, write for our data sheet and technical report on the properties and reactions that mark these fluorine-containing acetones as potentially valuable.

Mail coupon now for data on properties and reactions. Please attach company letterhead.

Product Development Department
General Chemical Division
Allied Chemical Corporation
40 Rector Street
New York 6, N. Y.

S-30

Please send data sheet on fluorine-containing acetones ☐

Please send report on fluorine-containing acetones ☐

Name

Title

Company

Address

City State



GENERAL CHEMICAL DIVISION

40 Rector Street, New York 6, N. Y.

ELECTROLYTIC CONDUCTIVITY IS OUR BUSINESS!

Industrial Instruments offers the most complete line of electrolytic conductivity equipment for the measurement and control of solution concentration. Standard models are available for use in all conductive solutions, ranging from distilled water to concentrated acid and alkalis, and in all temperature ranges.



**TYPE RC LABORATORY
CONDUCTIVITY BRIDGE**

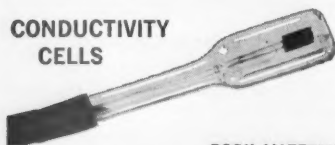
VERSATILE: Wide range of measurement from 0.2-2,500,000 ohms and 0.4-5,000,000 micromhos

ACCURATE: Within plus or minus 1% of resistance.

VARIABLE SENSITIVITY: Up to maximum of $\pm 1\%$. Adjustable for rapid balancing.

EXTRA LONG SCALE: 84" effective length.

CONDUCTIVITY CELLS



BODY MATERIAL:

To fill every temperature, pressure, or corrosion resistance requirement. Polystyrene, lucite, epoxy, nylon, polyethylene, bakelite, hard rubber, teflon, Kel-F, stainless steel, nickel, Monel or glass.

ELECTRODE MATERIALS: Nickel, platinum, graphite, gold or tin.

PHYSICAL RANGE: Pressure up to 7000 psi. Temperature up to several hundred degrees F.

CONDUCTIVITY RANGE: Complete line of cell constants for all applications from measurement of ultra pure water to highly concentrated solutions of acids, alkalis and salts.

**WRITE . . . for latest Conductivity
Equipment Catalog and Price List**



**Industrial
Instruments Inc.**

89 Commerce Road, Cedar Grove, Essex County, N. J.

New York, N.Y. (H. W. Deane, Albert Einstein College of Medicine, Bronx 61, N.Y.)

10-11. American Soc. for Artificial Internal Organs, Chicago, Ill. (C. K. Kirby, ASFAIO, 3400 Spruce St., Philadelphia 4, Pa.)

11-13. American College of Surgeons, Minneapolis, Minn. (H. P. Saunders, 40 E. Erie St., Chicago 11, Ill.)

11-13. Electrical Engineering in Space Technology, 1st conf. (AIEE), Dallas, Tex. (B. J. Wilson, Naval Research Laboratory, Washington, D.C.)

11-13. Forest Tree Growth, intern. conf., Tucson, Ariz. (Forest Tree Growth Conf., Laboratory of Tree-Ring Research, Univ. of Arizona, Tucson.)

11-14. American College Personnel Assoc., Philadelphia, Pa. (M. D. Hardee, Florida State Univ., Tallahassee.)

11-14. American Meteorological Soc., 8th weather radar conf., San Francisco, Calif. (H. G. Houghton, AMS, Dept. of Meteorology, Massachusetts Inst. of Technology, Cambridge 39.)

11-15. American Assoc. of Immunologists, Chicago, Ill. (C. Howe, Columbia Univ., College of Physicians and Surgeons, New York 22.)

11-15. American Inst. of Nutrition, Chicago, Ill. (G. M. Briggs, Div. of General Medical Sciences, National Institutes of Health, Bethesda, Md.)

11-15. American Physiological Soc., Chicago, Ill. (R. G. Daggs, 9650 Wisconsin Ave., NW, Washington 14.)

11-15. American Soc. for Experimental Pathology, Chicago, Ill. (F. J. A. McManus, Univ. of Alabama Medical Center, Birmingham.)

11-15. American Soc. for Pharmacology and Experimental Therapeutics, Chicago, Ill. (K. H. Beyer, Merck, Sharp & Dohme Research Laboratories, West Point, Pa.)

11-15. Federation of American Soc. for Experimental Biology, Chicago, Ill. (M. O. Lee, 9650 Wisconsin Ave., NW, Washington 14.)

11-16. American Assoc. of Anatomists, New York, N.Y. (L. B. Flexner, Dept. of Anatomy, School of Medicine, Univ. of Pennsylvania, Philadelphia 4.)

11-16. American Soc. of Biological Chemists, Chicago, Ill. (F. W. Putnam, Dept. of Biochemistry, Univ. of Florida, Gainesville.)

11-16. Anatomical Congress, 7th intern., New York, N.Y. (D. W. Fawcett, Dept. of Anatomy, Harvard Medical School, Boston 15, Mass.)

11-16. Congress of Anatomy, 7th intern., New York, N.Y. (J. C. Hinsey, New York Hospital, Cornell Medical Center, 525 E. 68 St., New York 21.)

12. Microcirculatory Conf., 8th, New York, N.Y. (H. J. Berman, Dept. of Biology, Boston Univ., Boston 15, Mass.)

12-13. Microbial Genetics, symp., London, England. (B. W. Lacey, Soc. for General Microbiology, Dept. of Bacteriology, Westminster Medical School, London, S.W.1.)

13-15. American Public Health Assoc. (Southern Branch), Memphis, Tenn. (L. M. Groves, Shelby County Health Dept., Memphis.)

15-16. Eastern Psychological Assoc., New York, N.Y. (C. H. Rush, Standard



Temperature range from 5° to 50°C with overall temperature uniformity meeting rigid APHA specs . . . more than a BOD cabinet . . . versatile enough for drug storage, serum studies, dairy product testing, many more tasks . . . external controls . . . forced air circulation . . . unobstructed interior . . . increased working space at NO increase in price . . . write today for Bulletin 303 and the name of your nearest stocking distributor.

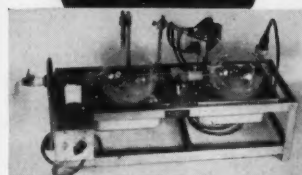
SINCE 1920

**PRECISION
SCIENTIFIC CO.** **PSI**

3737 West Cortland St., Chicago 47, Ill.

Local Offices in Chicago • Cleveland • Houston
New York • Philadelphia • San Francisco

FLASH EVAPORATOR



Continuous Model No. FE-2C

Evaporation under reduced pressure — particularly valuable when aqueous solutions and high boiling solvents (e.g., butanol) are used.

- Ideal for separation of: Concentrated solutions that would otherwise foam Heat and air sensitive solutions
- Performs separations in a fraction of the time required by conventional methods
- Easily disassembled to remove solute and also for cleaning

PRICE COMPLETE (with Thermo Regulator), F.O.B. New York \$330.00

Also available: **FLASH EVAPORATOR FE-2**, Regular model for single batches. Price complete \$215.50 F.O.B. N. Y.

Write for additional information



INSTRUMENTATION

ASSOCIATES

Distributors of

Laboratory and Scientific Specialties
17 West 60th Street New York 23, N. Y.

Oil Co. (N.J.), Rockefeller Plaza, New York, N.Y.)

16. Pennsylvania Acad. of Science, Williamsport. (K. B. Hoover, Messiah College, Grantham, Pa.)

18-19. Automatic Techniques Conf., 3rd annual, Cleveland, Ohio. (N. S. Hibshman, American Inst. of Electrical Engineers, 33 W. 39 St., New York 18.)

18-19. Radioactivity in Man, Measurements and Effects of Internal Gamma Ray Emitting Radiosotopes, AAAS symp., Nashville, Tenn. (G. R. Meneely, School of Medicine, Vanderbilt Univ., Nashville 5.)

18-20. National Watershed Conf., 7th, Washington, D.C. (J. H. Jones, American Watershed Council, Fairmont, W.Va.)

18-21. American Astronomical Soc., Pittsburgh, Pa. (J. A. Hynek, Smithsonian Astrophysical Observatory, 60 Garden St., Cambridge 38, Mass.)

18-22. Association of American Geographers, Dallas, Tex. (A. C. Gerlach, Map Div., Library of Congress, Washington 25.)

18-22. European Soc. of Ophthalmology, 1st cong., Athens, Greece. (P. Velissaropoulos, c/o Ophthalmology Clinic, Faculty of Medicine, 26, rue de l'Université, Athens, Greece.)

19-21. Active Networks and Feedback Systems, 10th intern. symp., New York, N.Y. (H. J. Carlin, Microwave Research Inst., Polytechnic Inst. of Brooklyn 55 Johnson St., Brooklyn 1, N.Y.)

19-21. American Soc. of Lubrication Engineers, annual, Cincinnati, Ohio. (C. L. Willey, ASLE, 84 E. Randolph St., Chicago, Ill.)

19-22. Metallurgy of Plutonium—session on nuclear fuels, intern. symp., Grenoble, France. (Société Française de Métallurgie, 25, rue de Clichy, Paris, France.)

20-21. Council on Medical Television, 2nd meeting, Bethesda, Md. (J. Mackenzie, Council on Medical Television, 33 E. 68 St., New York 21.)

20-22. Biological Waste Treatment, 3rd conf., New York, N.Y. (W. W. Eckenfelder, Dept. of Civil Engineering, Manhattan College, New York 71.)

20-22. Manned Space Stations Inst. of the Aeronautical Sciences symp., Los Angeles, Calif. (E. Levin, Rand Corp., 1700 Main St., Santa Monica, Calif.)

20-22. Medical Electronics, natl. conf., Houston, Tex. (K. O. Heintz, Humble Oil and Refining Co., Houston.)

20-22. Southwestern Inst. of Radio Engineers, 12th annual, Houston, Tex. (H. E. Childers, College of Medicine, Baylor Univ., Waco, Tex.)

20-23. National Council of Teachers of Mathematics, Ann Arbor, Mich. (M. H. Ahrendt, 1201 16 St., NW, Washington 6.)

20-24. Congress of Gastroenterology, 6th intern., Leyden and Noordwijk aan Zee, Netherlands. (C. Schreuder, 16, Lange Voorhout, The Hague, Netherlands.)

21-22. Society of Technical Writers and Editors (Technical Publishing Soc.), 7th annual, Chicago, Ill. (R. F. Ellis, American Can Co., 11th Ave. and St. Charles Rd., Maywood, Ill.)

21-23. Association of Southeastern Biologists, New Orleans, La. (H. J. Humm, Dept. of Botany, Duke Univ., Durham, N.C.)

Now...you can afford it!



THE SPECTRONIC 505

*A UV-visible Recording Spectrophotometer,
now at a price you can justify.*

The new Bausch & Lomb 505 Double Beam Single Detector Ratio Recording Spectrophotometer offers you a brand new combination of performance features:

A double grating monochromator with a band pass of 0.5 millicron

Built-in mercury source for tracing wavelength calibration lines right on the sample curve

Choice of light sources; three combinations available

Drum chart with linear wavelength recording in %T or Absorbance

Electronic Sensor automatically slows scanning speed to record all peaks with minimum overshoot.

AT LESS THAN HALF THE PRICE OF OTHERS

Will No. 32001N, for Visible Range . . . only \$3,685.00

Will No. 32000N, for UV and Visible . . . only \$4,285.00

Be sure of dependable performance. Have your "505" installed by a spectrophotometer specialist, a factory-trained Will service-man, from any of Will's convenient supply and service centers. Let Will's spectrophotometer "know-how" give you top performance, minimum down-time . . . Will specialists keep hundreds of such instruments operating year after year . . . Your assurance of complete Spectronic 505 satisfaction.

SOUND INTERESTING? Write or call for new 505 Brochure, contact your nearby Will Center for demonstration, and specify "Will" when you order.

Will CORPORATION

and subsidiaries



**Specialists in
Scientific Supply**

ROCHESTER 3, N.Y. • ATLANTA 1, GA. • NEW YORK 52, N.Y. • BALTIMORE 24, MD.
BUFFALO 5, N.Y. • SO. CHARLESTON 3, W. VA.

21-28. American Soc. of Tool Engineers, annual, Detroit, Mich. (H. E. Conrad, ASTE, 10700 Puritan Ave., Detroit.)

22-23. High-Temperature Resistance and Thermal Degradation of Polymers, symp., London, England. (Symposium Subcommittee, Plastics and Polymer Group, Soc. of Chemical Industry, 14 Belgrave Sq., London, S.W.1, England.)

24-28. American Ceramic Soc., annual, Philadelphia, Pa. (F. P. Reid, ACS, 4055 N. High St., Columbus 14, Ohio.)

25-27. American Proctologic Soc., Houston, Tex. (N. D. Nigro, 10 Peterboro, Detroit 1, Mich.)

25-27. Canadian Inst. of Mining and Metallurgy, 62nd annual, Toronto, Ontario, Canada. (Secretary-Treasurer, Room

906, Drummond Bldg., 1117 St. Catherine St., Montreal, Canada.)

25-27. International Acad. of Pathology, Memphis, Tenn. (F. K. Mostofi, Armed Forces Inst. of Pathology, Washington, D.C.)

25-28. American Assoc. of Petroleum Geologists, Atlantic City, N.J. (H. T. Morley, Pan American Petroleum Corp., Box 591, Room 1330, Tulsa 2, Okla.)

25-28. Society of Economic Paleontologists and Mineralogists, Atlantic City, N.J. (J. Imbrie, Dept. of Geology, Columbia Univ., New York, N.Y.)

25-30. American Acad. of Neurology, Miami, Fla. (Mrs. J. C. McKinley, 4307 E. 50 St., Minneapolis, Minn.)

25-30. Industrial Health, conf., Roches-

ter, N.Y. (M. E. Fairbank, Kodak Park, Rochester 4.)

26-29. Internal Medical Assoc., Rochester, N.Y. (C. D. Bridges, 28 E. Jackson Blvd., Chicago 4.)

27. Additives and Residues in Human Foods, symp., Columbia, Mo. (T. D. Luckey, Dept. of Biochemistry, School of Medicine, Univ. of Missouri Medical Center, Columbia.)

27. International Acad. of Proctology, annual, Miami Beach, Fla. (A. J. Cantor, IAP, 147-41 Sanford Ave., Flushing 55, N.Y.)

27-29. Algae and Metropolitan Wastes, conf., Cincinnati, Ohio. (A. F. Bartach, Water Supply and Water Pollution Research, Robert A. Taft Sanitary Engineering Center, Cincinnati.)

27-29. Chemical Reaction Engineering—Section on Non-Conventional Reactors, 2nd European symp., Amsterdam, Netherlands. (P. J. Hoftijzer, Centraal Laboratorium Staatsmijnen, Geleen (L.), Netherlands.)

27-30. American Meteorological Soc., general meeting with American Geophysical Union, Washington, D.C. (K. C. Spengler, AMS, 45 Beacon St., Boston 8, Mass.)

28-30. American Assoc. of Pathologists and Bacteriologists, Memphis, Tenn. (R. L. Holman, Dept. of Pathology, Louisiana State Univ., School of Medicine, New Orleans.)

28-30. American Soc. of Human Genetics, Memphis, Tenn. (W. J. Schull, Dept. of Human Genetics, Univ. of Michigan, 1133 E. Catherine St., Ann Arbor.)

28-30. Current Concepts in Medicine, 2nd intern. symp., Philadelphia, Pa. (M. J. Schwartz, Deborah Hospital, 901 Walnut St., Philadelphia 7.)

28-30. Midwestern Psychological Assoc., Columbus, Ohio. (I. E. Farber, Dept. of Psychology, State Univ. of Iowa, Iowa City.)

29. Parenteral Drug Assoc., Philadelphia, Pa. (H. E. Boyden, PDA, 4865 Stenton Ave., Philadelphia 44.)

29-30. Thermonuclear Processes, conv., London, England. (Institution of Electrical Engineers, Savoy Pl., London, W.C.2.)

30. Idaho Acad. of Science, annual, Pocatello. (A. E. Taylor, Graduate Div., Idaho State College, Pocatello.)

30-2. Society for American Archaeology, Salt Lake City, Utah. (D. A. Baerreis, Sterling Hall, Univ. of Wisconsin, Madison 6.)

May

1-2. American Soc. for Clinical Investigation, Atlantic City, N.J. (S. J. Farber, New York University College of Medicine, 550 First Ave., New York 16)

1-5. American Assoc. of Cereal Chemists, Chicago, Ill. (J. W. Pence, Western Utilization Research and Development Div., 800 Buchanan St., Albany 10, N.Y.)

1-5. Electrochemical Soc., Chicago, Ill. (H. B. Linford, ES, 1860 Broadway, New York 23)

1-5. Society of American Bacteriologists, 60th annual, Philadelphia, Pa. (D. M. Cleary, Box 354, Upper Darby, Pa.)

2. American Federation for Clinical

Spotlights pH Meters

With our comprehensive line of pH meters—ranging from the ultra-sensitive Beckman Model GS to the inexpensive Beckman Pocket Model—we offer the proper instrument for your particular need.

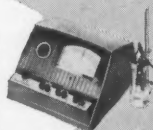
Representative models are described briefly below. We welcome your requests for more detailed information.

**HARSHAW
SCIENTIFIC**



H-29604—Beckman Pocket pH meter, battery operated. 6" x 3" x 2" deep. Light weight with unique combination glass and reference electrode which permits holding meter in one hand while taking readings, leaving the other hand free for recording... **\$99.50**

H-28915—Beckman Zero-matic pH meter, line operated. Simply push button and take pH or millivolt reading. Drift free, no warm-up time, line voltage compensation, continuous 0-14 pH scale. Outlets provided for recorder, polarizing current, etc... **\$295.00**



H-28901—Beckman Model GS pH meter, battery operated. For special pH problems and applications requiring extreme precision. This ultra-sensitive instrument is accurate to 0.0025 pH. The meter is a modified model G, which provides 20 times the sensitivity of standard null-meter measuring circuits. Utilizes same electrodes as model G... **\$625.00**



H-28900—Beckman Model G pH meter, battery operated. Designed for highest precision and versatility in pH studies, oxidation-reduction potential measurements and titrations with accuracy and reproducibility to ± 0.02 pH... **\$475.00**



H-29602—Beckman Model N-2 pH meter. A compact, battery operated meter in carrying case designed especially for portability. Ideal for field use. Range 0-14 pH. Case has compartment for electrodes, breaker and solutions... **\$360.00**



H-29601—Beckman Model N-1 pH meter, battery operated. Range 0-14 pH. Temperature compensator covers 0-100°C. Rapid measurements to 0.1 pH and with careful technique to 0.03 pH. **\$310.00**



Service facilities and complete electrode stocks are maintained at all Harshaw Scientific Branches

HARSHAW SCIENTIFIC

Division of The Harshaw Chemical Co. • Cleveland 6, Ohio

SUPPLYING THE NATION'S LABORATORIES FROM COAST TO COAST

SALES BRANCHES AND WAREHOUSES
CLEVELAND 6, OHIO
1945 East 97th Street

CINCINNATI 13, OHIO
6365 Wishes Road
DETROIT 28, MICH.
9240 Hubbard Ave.

HOUSTON 11, TEXAS
4622 Supply Row
LOS ANGELES 22, CAL.
3237 So. Garfield Ave.

OAKLAND 1, CAL.
3251 East 8th Street
PHILADELPHIA 48, PA.
Jackson & Swanson Sts.

SALES OFFICES • Atlanta 8, Ga. • Baton Rouge 6, La. • Buffalo 2, N.Y. • Hastings-On-Hudson 6, N.Y. • Pittsburgh 22, Pa.

VERSATILE

GME FRACTION COLLECTING EQUIPMENT provides

6 different models to suit your specific needs

Model V10
Model T10
Model D10

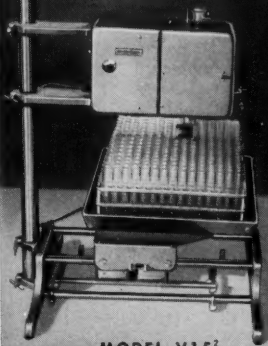
Model V15²
Model T15²
Model D15²

Send for complete descriptive brochure.

GME

SQUARE FRACTIONATOR

collects directly into test tube racks



MODEL V15²

- ★ Accurate collection in 225 test tubes
- ★ 450 tedious test tube transfers are eliminated
- ★ Equipped with 3 racks — each with 5 rows, 15 tubes per row
- ★ Improved volumetric unit
- ★ Timer or N.I.L. drop counter attachment available

The racks themselves, with all the test tubes in the order collected, may be removed from the fractionator for further processing.

GILSON MEDICAL ELECTRONICS

On Madison's West Beltline Highway
Middleton, Wisconsin

ANNOUNCING

the 1960 edition of the

INTERMEDIARY METABOLISM CHART

by

Drs. H. J. Sallach and R. W. McGilvery

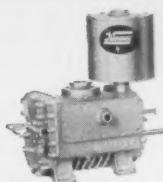
This chart is made available at approximate cost. It is in two parts, each part the size of the 1957 edition, which is now out of print. The price of each set of two parts is \$1.00. In lots of 50 or more, the price is 65¢ per set.

Is Your Laboratory Keeping Pace With New Developments in—

Kinney®

HIGH VACUUM

The urgency for more information—faster—places a higher burden than ever on research facilities and personnel. KINNEY, pioneers in High Vacuum, are abreast of today's and tomorrow's needs in advanced design High Vacuum Equipment for the Laboratory, Pilot Plant or full Production.

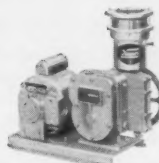


SINGLE STAGE PUMPS

The famous KINNEY Rotary Piston Mechanical Pump, producing pressures to 10 microns. The broadest selection in the world—thirteen sizes from: 13 cfm to 850 cfm free air displacement... every Pump test-run to exceed rated performance.



Bulletin 3120.1

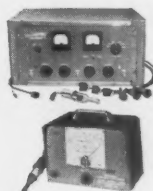


TWO STAGE PUMPS

Attaining ultimate pressures in the order of .2 micron, KINNEY Two Stage Mechanical Pumps offer special advantages in speed of pump down, low cost operation and freedom from maintenance. Six sizes: from 2 cfm to 46 cfm free air displacement.



Bulletin 3150.1



VACUUM GAGES

Cabinet and Panel mounted Gages to provide new standards of accuracy in ranges of 1 to 3000 microns and 3000 microns to 10-7 mm Hg. The famous Series GCT Compensated Thermocouple Gage which eliminates need for matching tubes and the new Series GICT Ionization-Thermocouple Gage.



Bulletin 3800.1
Bulletin 3811.1



VACUUM VALVES

A new series of Sweat Fitted Bronze Bellows Valves is now available in the comprehensive KINNEY Line of Vacuum Valves. Featuring a design that permits replacement of bellows without disturbing installation, these new Valves are available in 1", 1½", 2" and 3" sizes.



Bulletin 3421.1A

KINNEY VACUUM DIVISION

THE NEW YORK AIR BRAKE COMPANY

3538C WASHINGTON STREET • BOSTON 30 • MASS.



Please send me latest Bulletins on:

- ☐ Single Stage Pumps ☐ Two Stage Pumps
☐ Vacuum Gages ☐ Vacuum Valves

Name _____

Company _____

Address _____

City _____ Zone _____ State _____

*Write for
Bulletins
Today!*

NATIONAL APPLIANCE

General Purpose-Serological WATER BATH

Now, a more efficient water bath for Wassermann, Kolmer and Kahn tests, inactivations, serological techniques, general and ASTM methods, and many other applications. This and other National water baths can each be adapted to many types of service.

National's exclusive "V" bottom and immersion element maintains uniform temperature throughout bath to within $\pm 0.5^\circ \text{C}$. Five or seven inch depths obtained by simply reversing rack. Instrumentation includes a highly sensitive graduated hydraulic thermostat with 100% repeatability, thermometer, switch and pilot light. Thermometer well is outside of cover area. Temperature range from room to 100°C ., covered, 70°C ., uncovered. This and other National Water baths available for immediate delivery.

Write for bulletin or catalog of complete National Appliance line of apparatus.



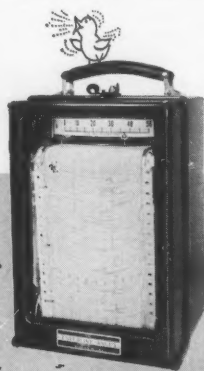
NATIONAL APPLIANCE

Here's one that doesn't have
to be "Mothered"

You get continuous,
trouble-free service
from this rugged,
reliable, direct-writing

RECORDING

D. C. MICROAMMETER by Esterline Angus



Built to "take it," this new D.C. Microammeter combines famous E/A excellence of design and ruggedness of construction with the extra-sensitivity of 50-500 microamperes at 200 ohms input resistance.

The simplicity of its direct-writing movement eliminates the complexity associated with servo or linkage driven writing systems.

It's a time-saver, too, with no unnecessary adjustments—such as con-

tinually setting zero. You put this D.C. Microammeter into operation merely by connecting the input leads.

Here's the recording instrument of a thousand and one uses. Send for Catalog Section No. 41 and see how it can help you.

The Esterline-Angus Company

No. 1 in fine Graphic Instruments for
more than 50 years.

DEPT. L, P.O. BOX 596, INDIANAPOLIS 6, IND.

Research, Atlantic City, N.J. (J. E. Bryan, 250 W. 57 St., New York 19)

2-3. Reactions between Complex Nuclei, 2nd conf., Gatlinburg, Tenn. (R. S. Livingston, Oak Ridge Natl. Laboratory, Oak Ridge, Tenn.)

2-4. Aeronautical Electronics, conf., Dayton, Ohio. (L. G. Cumming, IRE, 1 E. 79 St., New York 21)

2-5. Flight Test Symp., natl., San Diego, Calif. (H. S. Kindler, Instrument Soc. of America, 313 Sixth Ave., Pittsburgh 22, Pa.)

2-11. International Cancer Cytology conf., Mexico, D.F., Mexico. (Office of Intern. Conferences, Department of State, Washington 25)

2-11. Pan American Medical Assoc., cong., Mexico City, Mexico. (J. J. Eller, 745 Fifth Ave., New York 22)

3-4. Association of American Physicians, Atlantic City, N.J. (P. B. Beeson, Yale Univ. School of Medicine, New Haven 11, Conn.)

3-4. Conference of Veterinarians, annual, Philadelphia, Pa. (W. H. Rhodes, School of Veterinary Medicine, Univ. of Pennsylvania, Philadelphia 4.)

3-5. Society of Pediatric Research, Swampscott, Mass. (C. D. West, Children's Hospital, Cincinnati 29, Ohio)

3-6. Fuel Element Fabrication, symp., Vienna, Austria. (Intern. Atomic Energy Agency, 11 Kärntner Ring, Vienna)

5-6. American Pediatric Soc., annual, Swampscott, Mass. (A. C. McGuinness, 2800 Quebec St., N.W., Washington 8)

5-8. Wilson Ornithological Soc., Gatlinburg, Tenn. (A. M. Bagg, Farm St., Dover, Mass.)

6-7. Population Assoc. of America, annual, Washington, D.C. (K. B. Mayer, Dept. of Sociology and Anthropology, Brown Univ., Providence 12, R.I.)

6-7. South Dakota Acad. of Science, 45th annual, Brookings. (J. M. Winter, Dept. of Botany, Univ. of South Dakota, Vermillion.)

6-8. International Cong. of Phlebology, 1st, Chambéry, France. (J. Marmasse, 3, rue de la République, Orléans (Loiret), France)

6-9. American Psychoanalytic Assoc., annual, Atlantic City, N.J. (Mrs. H. Fischer, 36 W. 44 St., New York 36)

7-8. Academy of Psychoanalysis, annual, Atlantic City, N.J. (M. Ross, American Psychiatric Assoc., 1700 18 St., N.W., Washington 9)

9. American Acad. of Child Psychiatry, annual, Atlantic City, N.J. (M. Ross, American Psychiatric Assoc., 1700 18 St., N.W., Washington 9)

9-10. American Soc. of Safety Engineers, Chicago, Ill. (A. C. Blackman, ASSE, 5 N. Wabash Ave., Chicago 2)

9-11. Aerospace Medical Assoc., 31st annual, Bal Harbour, Fla. (W. J. Kennard, AMA, Washington Natl. Airport, Washington 1)

9-11. Power Instrumentation, 3rd natl. symp., San Francisco, Calif. (H. S. Kindler, Instrument Soc. of America, 313 Sixth Ave., Pittsburgh 22, Pa.)

9-11. Radiation Research Soc., 8th annual, San Francisco, Calif. (E. L. Powers, RRS, Argonne Natl. Laboratory, Box 299, Lemont, Ill.)

9-12. American Rocket Soc., semi-annual, Los Angeles, Calif. (A. F. Den-

ham, ARS, 925 Book Bldg., Detroit 26, Mich.)

9-12. Instrumentation Automation Conf. and Exhibit, summer, San Francisco, Calif. (Instrument Soc. of America, 313 Sixth Ave., Pittsburgh 22, Pa.)

9-13. American Psychiatric Assoc., annual, Atlantic City, N.J. (C. H. H. Branch, 156 Westminster Ave., Salt Lake City, Utah)

9-14. Fermentation, intern. symp., Rome, Italy. (Intern. Fermentation symp., Istituto Superiore di Sanita, Viale Regina Elena, 299, Rome, Italy)

10-12. Electronic Components, conf., Washington, D.C. (N. S. Hibsham, AIEE, 33 W. 39 St., New York 18)

10-12. Farm Electrification, conf., Omaha, Neb. (N. S. Hibsham, AIEE, 33 W. 39 St., New York 18)

10-12. Severe Storms, American Meteorological Conf., St. Louis, Mo. (K. C. Spengler, AMS, 45 Beacon St., Boston 8, Mass.)

10-13. Fuel Element Fabrication, symp., Vienna, Austria. (Intern. Atomic Energy Agency, 11 Kärntner Ring, Vienna)

11. Society of Medical Psychoanalysts, annual, New York, N.Y. (M. Ross, American Psychiatric Assoc., 1700 18 St., N.W., Washington 9)

11-13. American Assoc. of Genito-Urinary Surgeons, Dearborn, Mich. (W. J. Engel, 2020 E. 93 St., Cleveland 6, Ohio)

11-13. American Assoc. of Physical Anthropologists, Washington, D.C. (E. E. Hunt, Jr., Peabody Museum, Harvard Univ., Cambridge 38, Mass.)

11-13. American Assoc. for Thoracic Surgery, 40th annual, Miami Beach, Fla. (H. T. Langston, 7730 Carondelet Ave., St. Louis 5, Mo.)

11-13. American Inst. of Chemists, Minneapolis, Minn. (L. Van Doren, AIC, 60 E. 42 St., New York 17)

11-13. International Acetylene Assoc., annual, Seattle, Wash. (IAA, 30 W. 42 St., New York 17)

11-13. Rare Earths in Biochemical and Medical Research, conf., Ames, Iowa. (J. G. Graca, College of Veterinary Medicine, Iowa State Univ., Ames)

11-14. American Helicopter Soc., annual natl. forum, Miami Beach, Fla. (H. M. Lounsbury, AHS, 2 E. 64 St., New York 21)

11-14. National Science Fair-International, Indianapolis, Ind. (Science Service, 1719 N. St., Washington 6)

12. Protein and Amino Acid Supplementation, Chicago, Ill. [J. T. Sime (Assoc. of Vitamin Chemists), Evaporated Milk Assoc., 228 North La Salle St., Chicago 1]

12-14. American Assoc. for Cleft Palate Rehabilitation, Denver, Colo. (D. C. Priestersbach, University Hospitals, Iowa City, Iowa)

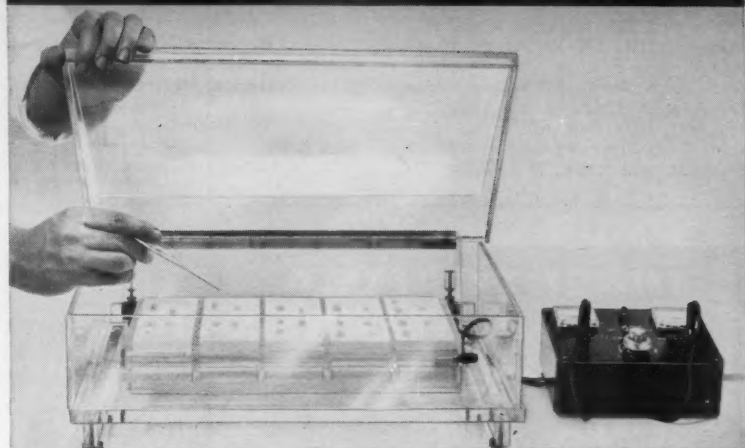
12-14. American Inst. of Industrial Engineers, annual, Dallas, Tex. (F. J. Tittler, AIIE, 145 N. High St., Columbus 15, Ohio)

13-14. Proctological Latina, 2nd intern., Rome, Italy. (G. B. E. Simonetti, Via S. Raffaele 3, Milano, Italy)

15-18. American Soc. of Maxillo-facial Surgeons, Los Angeles, Calif. (E. C. Hinds, 1508 Medical Towers, Houston 25, Tex.)

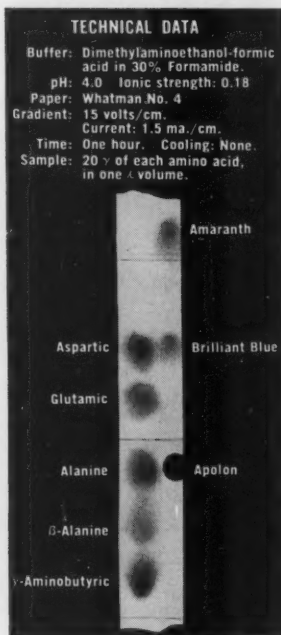
15-18. International College of Sur-

Rapid Paper Electrophoresis



New MISCO Unit Uses Organic Buffers, Completes Separations in 1 Hour

Misco's advanced multiple-cell electrophoretic techniques feature organic buffers for both analytical and clinical investigations. Usually within an hour, unknown compounds can be completely characterized or known samples separated for quantitative analysis. Just as rapidly, this flexible unit will purify up to a few milligrams of any compound that can be separated by electrophoresis.



The Misco apparatus and special organic buffers were developed by Dr. Harold T. Gordon of the University of California. Particular success has been achieved with small organic molecules such as amino acids, carbohydrates and peptides.*

The Gordon-Misco technique offers three key innovations — organic buffers in formamide, a multi-chamber cell, and reference dyes. The buffers minimize evaporation, allow much higher voltages. The multi-chamber cell is designed for running 1 to 5 samples simultaneously at 5 different pH values from 3.3 to 9.3. Reference dyes (such as Amaranth and Apolon) assure reproducible relative mobility values, often make possible the calculation of the pK and molecular weight of the unknown.

Misco will be happy to send you more information about rapid paper electrophoresis and a reprint of the Werum-Gordon-Thornburg article. Please address Dept. 98.

*Rapid Paper Ionophoresis Using Organic Buffers in Water-Formamide and Water-Urea. L. N. Werum, H. T. Gordon, W. Thornburg. *J. Chromatography* (in press).

MICROCHEMICAL SPECIALTIES CO.
1825 EASTSHORE HIGHWAY BERKELEY 10, CALIFORNIA
Specialists in Micro Techniques for 22 Years

geons, 12th biennial conf., Rome, Italy. (ICS, 1516 Lake Shore Drive, Chicago, Ill.)

15-20. American Water Works Assoc., annual conv., Miami Beach, Fla. (H. E. Jordan, AWWA, 2 Park Ave., New York 16)

15-19. Institute of Food Technologists, 20th annual, San Francisco, Calif. (C. S. Lawrence, IFT, 176 W. Adams St., Chicago 3)

15-20. National Tuberculosis Assoc., Los Angeles, Calif. (J. C. Stone, 1790 Broadway, New York 19)

16-17. Society of American Military Engineers, natl. conv., Washington, D.C.

(D. A. Sullivan, SAME, 140 S. Dearborn St., Chicago, Ill.)

16-18. American Ophthalmological Soc., Colorado Springs, Colo. (M. C. Wheeler, 30 W. 59 St., New York 19)

16-18. American Trudeau Soc., Los Angeles, Calif. (F. W. Webster, 1790 Broadway, New York 19)

16-19. American Urological Assoc., Chicago, Ill. (W. P. Didusch, 1120 N. Charles St., Baltimore 1, Md.)

16-20. Medical Library Assoc., Kansas City, Mo. (Miss N. A. Mehne, Upjohn Co. Library, 301 Henrietta St., Kalamazoo, Mich.)

16-21. American Assoc. on Mental

Deficiency, annual, Baltimore, Md. (N. A. Dayton, P.O. Box 51, Mansfield Depot, Conn.)

17-18. Superconductive Technique for Computing Systems, symp., Washington, D.C. (Miss J. Leno, Code 430A, Office of Naval Research, Washington 25)

17-20. American Assoc. of Plastic Surgeons, Milwaukee, Wis. (T. D. Cronin, 6615 Travis St., Houston 25, Tex.)

18-19. Agricultural Meteorology, 3rd conf., Kansas City, Mo. (K. C. Spengler, American Meteorological Soc., 45 Beacon St., Boston, Mass.)

18-20. Society for Experimental Stress Analysis, spring, Indianapolis, Ind. (W. M. Murray, SESA, P.O. Box 168, Central Square Station, Cambridge 39, Mass.)

18-27. Wool Conf., intern., Harrogate, Yorkshire, England. (A. W. Bennett, Textile Inst., 10 Blackfriars St., Manchester 3, England)

22-26. Air Pollution Control Assoc., 53rd annual, Cincinnati, Ohio. (C. W. Gruber, 2400 Beekman St., Cincinnati 14)

22-26. Oil and Gas Power Conf., Kansas City, Mo. (D. B. MacDougall, ASME, 29 W. 39 St., New York 18)

23-25. American Soc. for Quality Control, annual conv., San Francisco, Calif. (W. P. Youngclaus, Jr., ASQC, 161 W. Wisconsin Ave., Milwaukee 3, Wis.)

23-25. National Telemetering Conf., Santa Monica, Calif. (A. F. Denham, American Rocket Soc., 925 Book Bldg., Detroit 26, Mich.)

23-25. Technical Assoc. of the Paper and Pulp Industry, Chicago, Ill. (J. Winchester, TAPPI, 155 E. 44 St., New York 17)

23-26. Design Engineering Conf., New York, N.Y. (D. B. MacDougall, ASME, 29 W. 39 St., New York 18)

23-28. American College of Cardiology, 9th annual conv., Indianapolis, Ind. (G. F. Greco, ACC, 114-08 Linden Blvd., Ozone Park 16, N.Y.)

23-28. Instruments, Electronics, and Automation Exhibition, Olympia, London, England. (Industrial Exhibitions Ltd., 9 Argyll St., London, W.1., England)

23-28. International Ceramic Cong., 7th, Great Britain. (G. N. Hodson, Organizing Council, c/o Hatherware Ltd., Loughborough, England)

23-28. International War—Prophylaxis Cong. for Physicians, Noordwijk ann Zee, Netherlands. (M. Knap, 46 Schubertstraat, Amsterdam, Netherlands)

25-26. Refractory Metals and Alloys, symp., Detroit, Mich. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 18)

25-5. International Federation for Housing and Town Planning, cong., Puerto Rico. (IFHTP, Park Hotel, Molenstraat 53, The Hague, Netherlands)

26-27. Psychophysiological Aspects of Space Flight (School of Aviation Medicine, USAF Aerospace Medical Center), symp., San Antonio, Tex. (J. Harmon, Southwest Research Inst., 8500 Culebra Rd., San Antonio 6)

26-28. Society of Naval Architects and Marine Engineers, spring, Washington, D.C. (W. N. Landers, SNAME, 74 Trinity Pl., New York 6)

29-2. Chemical Inst. of Canada, 43rd annual conf., Montreal, Quebec, Canada. (CIC, 18 Rideau St., Ottawa, Ontario, Canada)

INJECT GAMMA EMITTERS SAFELY



HAMILTON LEAD SHIELDED SYRINGES

You get shielding equivalent to 4 hvs for gold or 16-fold radiation reduction with Hamilton Lead Shielded Syringes. Hamilton's 1/2 inch lead shielding is the lightest weight of shield-to-size yet devised.

- From a 3 3/4 lb., 10 cc model to a 1 1/2 lb., 2 cc model
- Accurate, engraved graduations on the shield
- Fits only American Cyanamid Interchangeable Syringes
- Plunger locks against accidental movement
- Syringe and hard chrome plated shield are autoclavable
- Beta shielded syringes also available, with or without Chaney Adaption



Order direct, or write today for literature and prices.
Also available through your supply house.

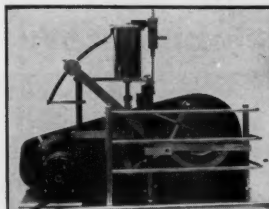
HAMILTON COMPANY, INC.

P. O. Box 307-K, Whittier, California

PRECISION MEASURING EQUIPMENT FOR CLINICAL AND MEDICAL RESEARCH

BIRD

RESPIRATION PUMP



**PRODUCES
ARTIFICIAL
BREATHING**

**VARIABLE
VOLUME
DELIVERY**

A special feature of this pump is that the piston is always driven to the top of its chamber—as a result no air is left in the chamber at the end of a stroke. Thus volume can be varied from zero to 500 cc per stroke while the pump is in operation. When the pump has reached its maximum on the pressure side, a mechanically operated valve disconnects the flow of air to the lungs and exhalation takes place naturally. Oxygen or gas mixtures may easily be admitted into the pump system.

No. 70-8791—Pump complete with motor and infinitely variable drive, giving speeds of 0-45 strokes per minute.

No. 70-879—Pump without motor and infinitely variable drive, but with four driving pulleys for variable speeds.

PHIPPS & BIRD, INC.

Manufacturers & Distributors of Scientific Equipment
6th & Byrd Streets - Richmond, Va.

DIFCO

Antisera and Antigens

Enteropathogenic Coli

Klebsiella

Salmonella

Shigella

Brucella

Leptospira

Streptococci



C Protein Antiserum and Standard



Infectious Mononucleosis Antigens
and Standards

Potent

Stable

Specific

Descriptive literature available on request

Specify

**DIFCO LABORATORY PRODUCTS
BIOLOGICS CULTURE MEDIA
REAGENTS**

the HITACHI HS-6 ELECTRON MICROSCOPE

The Hitachi HS-6 permanent magnet Electron Microscope provides a continuously variable magnification range of 2000x to 28000x. Focusing is achieved by altering the magnetic flux of the objective lens leaving the accelerating voltage unchanged.

One of the outstanding features of the Hitachi HS-6 is the guaranteed resolution of 20 Angstrom Units or better. The simplicity of operation, mechanics and circuitry makes the HS-6 an ideal Electron Microscope for the researcher in medical and biological fields.

Illustrated is a microphotograph of Cu-phthalocyanine, taken at 30,000X electronic magnification with the HS-61

Your inquiries are invited at either our West Coast or East Coast offices, where competent sales personnel will answer your questions, and arrange a demonstration.

ERB & GRAY SCIENTIFIC, Inc.

Exclusive Hitachi Distributors for the U. S.

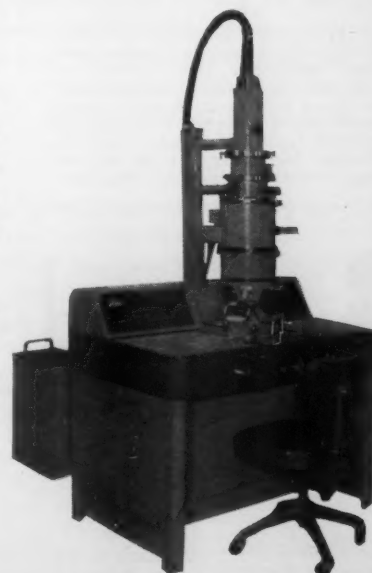
854 S. Figueroa St., Los Angeles 17, Calif.

New York Address

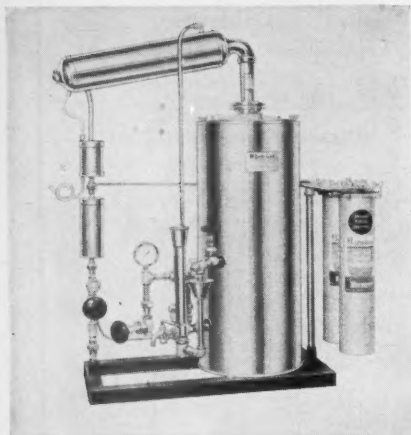
ERB & GRAY SCIENTIFIC, INC.

501 Fifth Avenue

New York 17, New York



DISTILLED WATER OF THE HIGHEST PURITY



FROM THE STILL YOU NEVER HAVE TO CLEAN

Now it is possible to produce distilled water of from 800,000 to 2,000,000 ohm electrical resistance with the NEW BARNSTEAD Condensate Feedback Purifier. Total solids do not exceed .02 to .05 parts per million. Not only do you get distilled water of higher purity but maintenance and upkeep time is completely eliminated. Operating principle is simple and efficient: the boiler steam which is used to heat the Still is first condensed through a flash cooler. This water is then passed through a demineralizer and an organic removal unit before being introduced into the evaporator of the Still.

By this pretreatment, amines and other boiler treatment compounds are eliminated, and final distillation then removes all traces of bacteria, pyrogens, organic matter, etc. Since this pretreatment removes all mineral solids from the feedwater, no scale or hard deposits can form within the Still. Neither the boiler nor the coil will ever require scale removal or scraping.

Write for Bulletin No. 145-A.

Barnstead
TRADE MARK REG. U.S. PAT. OFF.
STILL AND STERILIZER CO.
49 Lanesville Terrace, Boston 31, Mass.

BOSTON
Jamaica
4-3100

NEW YORK
Kingsbridge
8-1557

CLEVELAND
Academy
8-6622

CHICAGO
Rogers Park
1-6173

PHILADELPHIA
Locust
8-1786

DETROIT
Enterprise
7422

LOS ANGELES
Ryan
1-6663

SAN FRANCISCO
Templebar
2-5391

WASHINGTON, D.C.
District
7-1142

New Products

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Neither Science nor the writer assumes responsibility for the accuracy of the information. A coupon for use in making inquiries concerning the items listed is included in the post card insert. Circle the department number of the items in which you are interested on this coupon.

■ **WHEATSTONE BRIDGE** measures resistance from 0 to 11,111 Mohm. Complete guarding is said to assure accuracy of ± 0.01 percent to 1 Mohm and ± 0.02 percent to 100 Mohm. Resistors may be tested at full battery potential up to 150 volts. The bridge is adjusted by dial-type selector switches. (Leeds & Northrup Co., Dept. Sci383, 4934 Stenton Ave., Philadelphia 44, Pa.)

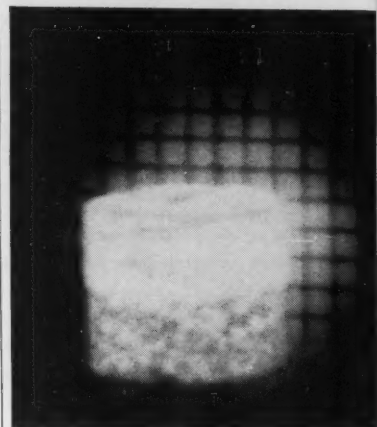
■ **DIGITAL-TO-ANALOG CONVERTER** consists of individual solid-state modules for each input bit. Inputs are a digital number and an a-c voltage. Output is an a-c voltage of identical frequency and of amplitude equal to the product of the inputs. Accuracies of ± 0.025 percent and switching times less than 100 μ sec are said to be available, with phase shift of 5 deg at 200 kcy/sec. Operating temperature range is -54° to $+95^{\circ}\text{C}$. A ten-bit device occupies less than 20 in³. (Packard Bell Computer Corp., Dept. Sci391, 1905 Armacost Ave., Los Angeles 25, Calif.)

■ **TEMPERATURE MEASURING INSTRUMENT** for use with resistance-type temperature probes measures from -425° to $+800^{\circ}\text{F}$ in 12 ranges, selected by push button. Accuracy is said to be $\pm 0.5^{\circ}\text{F}$ over the major portion of the range. Power supply can be either a self-contained battery or a 60-cy/sec, 110-volt source. Full interchangeability among probes and instruments is provided. (Trans-Sonics Inc., Dept. Sci392, Burlington, Mass.)

■ **NOISE INTEGRATOR** designed to be used with the manufacturer's noise survey meter reads either noise exposure integrated over 5 sec or average noise level with an averaging time constant of 3 sec. A weighted frequency-response signal that emphasizes the frequency ranges in which the ear is susceptible to damage is fed into the instrument from the survey meter. The instrument is designed to be strap-carried by the operator, which leaves his hands free. (Mine Safety Appliance Co., Dept. Sci393, Pittsburgh, Pa.)

■ **X-Y RECORDER** is designed to operate with differential-transformer input to provide multiplication of mechanical movement by a factor of 1000. Motion as small as 20 μ in. is said to be detectable, with total error less than ± 0.15 percent. Chart size is 24 by 36 in. A dual vacuum-hold-down system permits

ISOTOPES for Your Development Work



Oak Ridge National Laboratory offers more than 300 radioactive and stable isotope products.

RADIOISOTOPES

Fission Products—Kilocurie quantities of cerium-144, cesium-137, promethium-147 and strontium-90 available. Orders for sources will be completed to your specifications.

Processed Solutions—90 processed radioisotopes may be obtained, including many carrier-free and high specific activity products.

STABLE ISOTOPES

- More than 200 stable isotopes available from 50 elements.
- Chemical processing and target fabrication services also offered.
- Ultra-high isotopic purity in a number of isotopes.

For information or literature, write to: Isotopes Division, Oak Ridge National Laboratory, P. O. Box X, Oak Ridge, Tennessee.



**OAK RIDGE
NATIONAL LABORATORY**

Operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION



use of half-size sheets. Standard pen speed is 2 in./sec; special speeds to 20 in./sec can be supplied. (Houston Instrument Corp., Dept. Sci394, 1717 Clay Ave., Houston 3, Tex.)

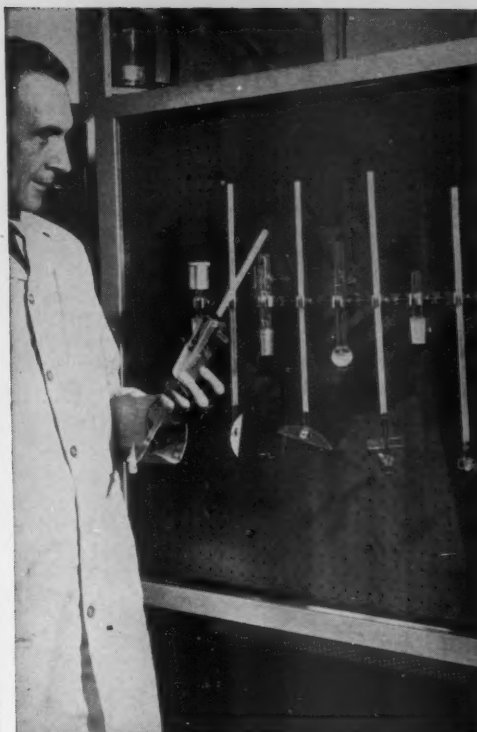
■ **RECORDING SPECTROPOLARIMETER** measures rotatory dispersion over the 200 to 700 $m\mu$ wavelength range. The optical system of the instrument includes a xenon-lamp source with electromagnetic-field arc control; a Littrow monochromator of spectral dispersion varying from 1.3 $m\mu/mm$ at 200 $m\mu$ to 50 $m\mu/mm$ at 700 $m\mu$; and a polarimeter. A servosystem drives the polarizer prism to compensate for the optical rotation introduced by the sample. The recorder is mechanically linked to the wavelength-scan or time-scan motions and to the polarizer-prism rotation. Three optical-rotation ranges are 2, 20 and 200 deg, dextro or levo. Sensitivity of optical rotation measurement is ± 0.001 deg. Recording chart area is 500 by 1000 mm. Scanning times range from 5 to 2000 min at nine speeds. Provision is made for kinetic recording at fixed wavelength. (Rudolph Instruments Engineering Co., Dept. Sci387, Little Falls, N.J.)

■ **PALLADIUM LEAK VALVE** for control of flow of hydrogen and deuterium consists of a chamber 3.5 in. in diameter and 4.5 in. high, with a palladium thimble. The valve is heated by an external 117-volt a-c heater. Input pressure can be as high as 15 lb/in.² gage. Input and output connections are female 1/4-in. diameter pipe fittings. (Scientific Engineering Laboratories, Inc., Dept. Sci415, 1510 Sixth St., Berkeley 10, Calif.)

■ **HIGH-VACUUM PUMP** is a cold-cathode discharge type designed to be permanently attached to vacuum devices such as microwave tubes to remove minute amounts of gas liberated during the life of the device. The pumps handle 0.7 lit./sec. Various modifications to expedite connection to complex devices are available. Pump with magnet weighs 2 lb. A matching power supply is available. (Ultek Corp., Dept. Sci396, 920 Commercial St., Palo Alto, Calif.)

■ **PUNCHED-TAPE READER** is designed to read a fixed block of information, up to 384 bits, on standard 1-in., 5- to 8-hole tape. Output terminals are available for all bits through brush contacts. (Wang Laboratories, Inc., Dept. Sci407, 12 Huron Dr., Natick, Mass.)

■ **MICROWAVE HARMONIC GENERATORS** are available in three models providing output frequencies from 53 to 90 kMc/sec. The generators consist of two wave guides coupled by a probe



**"STIR-LUBE"
LUBRICANT**
Prevents Damage
to-Glass Bearings

A superior low melting lubricant, makes thin films easy to apply. A necessity at over 500 R.P.M., has a load carrying capacity three times that of comparable petroleum oils.

For top performance, ACE Trubore® Stirrers....

TRUBORE® Stirrers, pioneered by Ace, feature a variety of well designed interchangeable bearings and rods. TRUBORE® Stirrers are manufactured to closest tolerances to give this outstanding performance: Average leak rate of only 6.4 mm. Hg/min. (unlubricated) at 760 mm. Hg differential pressure. For lubricated stirrers, leakage is less than 0.05 mm. Hg/min. for the same pressure differential. A pressure of 1 mm. absolute is attainable with unlubricated surfaces at speed of less than 100 R.P.M.

The performance, assured by individual gauging and inspection of every component before packing, has made the Ace TRUBORE® Stirrer the most widely used precision glass stirrer in research today. Try Ace TRUBORE® Stirrers. Full information in Catalog 60. Write Dept. S for your copy.

ACE GLASS

INCORPORATED

Louisville, Ky., Vineland N. J. Springfield, Mass.

Circle No. 855 on Readers' Service Card

structure terminated in a crystal element. The input wave guide receives the exciting frequency that is coupled to the crystal to cause harmonic generation in the output wave guide. (Narda Microwave Corp., Dept. Sci400, 118-160 Herricks Rd., Mineola, N.Y.)

■ **FILM CLEANER** is an automatic machine for the solvent cleaning of motion-picture film and magnetic-recorder tape. Speed is adjustable to 300 ft/min. Automatic shutoff leaves the machine threaded with leader for continuous operation. Only nonexplosive, noninflammable solvents are used.

Models are available for film sizes from 16 to 70 mm. (Computer-Measurements Co., Dept. Sci420, 12970 Bradley Ave., Sylmar, Calif.)

■ **HOT WIRE ANEMOMETER SYSTEM** for analysis of airstream turbulence measures longitudinal and transverse components. Separate constant-current supplies and separate d-c bridge circuits are provided for each of two wires. The instrument's amplifier is provided with adjustable frequency compensation to match hot-wire time constants between 0.23 and 30 msec. A sum-difference meter permits indi-

cation of each wire resistance separately, of their sum, or of their difference. A random-signal meter provides flat response within ± 0.2 db from 2 cy to 250 kcy/sec with averaging time constant of 0.5 or 16 sec. (Flow Corp., Dept. Sci429, 85 Mystic St., Arlington 74, Mass.)

■ **COUNTER-TIMERS** are completely transistorized instruments for the measurement of frequency and time and for counting. Three models available include a universal counter-timer, a frequency-period meter, and a time interval meter. Measurement ranges of the universal model are: d-c to 10 Mcy/sec for frequency; 0.1 m μ sec to 10⁷ sec for time interval and period. Accuracy is said to be ± 1 count \pm oscillator stability. Sensitivity is 0.25 volt r.m.s. and input impedance is 25 kohm/volt. Display is either by vertical numeral panels or by in-line gas-discharge numeral tubes. (Computer-Measurements Co., Dept. Sci405, 12970 Bradley Ave., Sylmar, Calif.)

■ **ANALOG-TO-DIGITAL CONVERTER** is a single-channel system that measures d-c voltages from 3 μ v to 1000 volts with accuracy of ± 0.05 percent and a recording speed of 10 measurements per second. Output from the device is a paper tape punched in binary-coded decimal form for use with computers. (Systron Corp., Dept. Sci413, 950 Galindo St., Concord, Calif.)

■ **DEUTERIUM ACCELERATOR TARGETS** carry more than 8 ml (STP) of deuterium gas occluded in each target. Targets are produced on 1.125 in. diameter titanium film with full active area. Molybdenum is used as backing material for the 20-mg film. (Scientific Engineering Laboratories, Dept. Sci414, 1510 Sixth St., Berkeley 10, Calif.)

■ **ANALOG COMPUTER** for training application is said to be student-proof in the sense that no permanent damage results from incorrect programing. It is a self-contained unit with five operational amplifiers, stabilized power supplies, and patching and control facilities. Interchangeability of component assemblies permits incorporation into more complex computer installations. (Solartron Electronic Group Ltd., Dept. Sci421, 45 Thames St., Kingston, Surrey, England.)

■ **TELEMETERING DECOMMUTATOR** for PAM and PDM signals is said to maintain synchronization with incoming data with changes in commutation speed up to ± 20 percent and over several segments of complete signal dropout. Cross talk is less than ± 0.1 percent. Translators supply output of ± 15 volts.



**BOTH POTASSIUM & SODIUM DETERMINATIONS
IN A SINGLE SOLUTION SAMPLING**

WITH B/A's NEW FLAME PHOTOMETER

SALES-SERVICE AND INFORMATION NOW AVAILABLE FROM OUR DISTRIBUTORS:

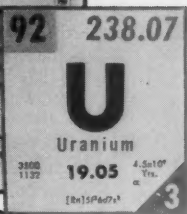
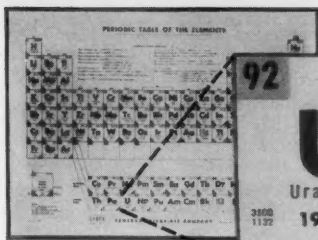
BARRY INSTRUMENTS, Miami
CANADIAN RESEARCH INSTITUTE, Toronto
A. DAIGGER & CO., Chicago
Los Angeles, Richmond, Cal.
DALLAS RADIONICS, Dallas
A. BRUCE EDWARDS, Philadelphia
ELECTRIC RESEARCH CORPORATION,
Atlanta
INSTRUMENTATION ASSOCIATES, INC.,
New York
MACALASTER-BICKNELL, Cambridge,
New Haven, Syracuse

PHYSICIANS & HOSPITALS SUPPLY CO.,
Minneapolis
SCHAAR & COMPANY, Chicago,
Indianapolis, Silver Spring, Md.,
Detroit, Olean, N.Y., Augusta, Ga.
SCIENTIFIC SUPPLIES CO., Seattle,
Portland, Ore., Spokane
SOUTHWESTERN SURGICAL SUPPLY CO.,
Albuquerque, El Paso, Phoenix
WILL CORPORATION, Rochester,
Baltimore, Buffalo, New York,
Atlanta, South Charleston, W. Va.

Write today for Bulletin F701
with full technical information
on B/A's NEW Flame
Photometer Model KY, to:



Baird-Atomic, Inc.
33 UNIVERSITY RD.,
CAMBRIDGE 38, MASS.



←This unit is $\frac{1}{8}$ actual size

Another NEW
LECTURE ROOM PERIODIC TABLE
LARGER • EASY TO READ • COLORFUL
INCLUDES ATOMIC DATA

Includes all elements and number of naturally occurring radioactive and stable isotopes. Shows atomic number in large type, also weight, density, boiling and melting points, electronic configuration, half-life, and important atomic constants for physics and chemistry. New large lecture room size, 62" x 52", in 4-colors on heavy plastic coated stock.

No. 12056 with wood strips and eyelets, each, \$7.50



CENTRAL SCIENTIFIC CO.

A Subsidiary of Cenco Instruments Corporation
1718-M Irving Park Road • Chicago 13, Ill.
Branches and Warehouses—Mountainside, N. J.
Boston • Birmingham • Santa Clara • Los Angeles • Tulsa
Houston • Toronto • Montreal • Vancouver • Ottawa

COLORADO SERUM ASSURES

Quality and Dependability

Colorado Serum Co. is a reliable source of supply for animal bloods and serums, diagnostic reagents, sheep blood products, complements, and a wide range of plasmas, ultrafiltrates, sterile serums and antisera.

*35 years of continuing research, testing and experience, never forfeiting quality.



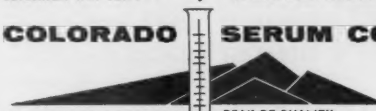
write for this
FREE CATALOG NOW!

No salesman will call...

*The best possible conditions prevail in maintaining our variety of animals.

*The newest equipment and highly experienced staff guarantees you can order with confidence from Colorado Serum Co.

COLORADO SERUM CO.



Laboratory and General Office

PEAK OF QUALITY

4950 YORK STREET • DENVER 16, COLORADO • MAin 3-5373

PHOTOVOLT DENSITOMETRIC EQUIPMENT
for ELECTROPHORESIS and CHROMATOGRAPHY

New building-block system permits adding of units as required, from manual and semi-automatic operation to fully-automatic recording and integrating

• For scanning of electrophoresis strips and readings on large sheets in chromatography

• For work in visible and ultraviolet ranges

• For evaluation by color-transmission, reflection or fluorescence

• For readings on filter paper, agar, starch and other gels

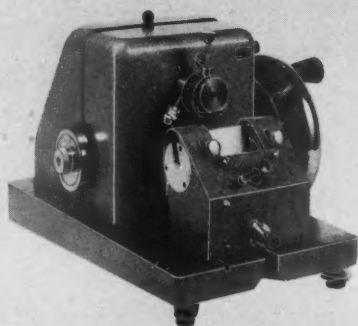


Write for Bulletin 800-5 to:

PHOTOVOLT CORPORATION

95 Madison Avenue • New York 16, N. Y.

**Absolutely Uniform Serial Sections
In Thicknesses of One Micron . .
(or as selected by user)**



JUNG

Precision Rotary Microtome "1120"

- AUTOMATIC FEED TO 40 MICRONS
- SECTION COUNTER AND SPECIMEN CONTROL
- KNIFE GUARDS FOR SAFE OPERATION
- UTMOST RIGIDITY—VIBRATION FREE

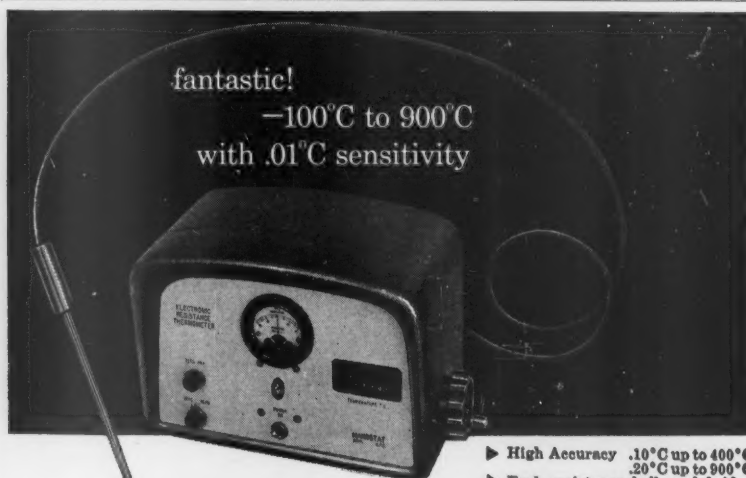
For further particulars or a demonstration, contact—

WILLIAM J. HACKER & CO., INC.

P. O. Box 646

Capital 6-8450

West Caldwell, N.J.



fantastic!
—100°C to 900°C
with .01°C sensitivity

Absolutely incredible . . . but absolutely true! For the first time ever, here is the only thermometer which covers a range from —100°C to 900°C, with .01°C sensitivity and digital reading of temperature directly.

read temperature directly • no calculations necessary

ELECTRONIC Resistance Thermometer



The EMIL GREINER Co.

30-36 N. MOORE STREET DEPT. 427, NEW YORK 13, N. Y.

PRICE LIST:

2352S	Electronic Resistance Thermometer without bulb. Either 2352SD or 2352SE or both must be ordered at the same time as the thermometer and these will be individually calibrated.	1105.00
2352SD	Stainless Steel Bulb, only.	395.00
2352SE	Quartz Bulb, only.	395.00
2352SF	Temperature controller, only.	112.50

Output impedance is less than 1.0 ohm from d-c to 1000 cy/sec. Translator accuracy of ± 0.07 percent is standard. Automatic zero level compensation and automatic gain compensation reduce zero shifts and full-scale shifts of ± 10 percent to less than ± 0.1 percent. (Telecomputing Corp., Dept. Sci422, 12838 Saticoy St., North Hollywood, Calif.)

■ **BATTERY POWER PACKS** consist of rechargeable nickle-cadmium battery cells potted in a plastic case for production in any size, shape, color and electrical capacity. The power packs can be specially formed to fill what may otherwise be considered dead space. The packs are hermetically sealed and are said to be shock resistant to 2000 grav. (Gulton Industries, Inc., Dept. Sci423, 212 Durham Ave., Metuchen, N.J.)

■ **NOISE GENERATOR** uses a 6D4 gas-discharge tube as a noise source with a magnetic field applied for stabilization. A two-stage amplifier includes noise-spectrum shaping filters selectable by panel switches. Two low-pass filters provide gradual roll-off above 30 and 500 kcy/sec, respectively. A third filter is a peaking network that compensates for the drop in output at high frequencies, so that a good spectrum can be obtained at 5 Mcy/sec. An 80-db attenuator provides metered outputs from 30 μ v to 3 volts. (General Radio Co., Dept. Sci425, West Concord, Mass.)

■ **MICROWAVE AMPLIFIER** offers broadband amplification with gain of 30 db and 10-mw output from 10.5 to 16 Mcy/sec. The amplifier uses a permanent-magnet-focused traveling-wave tube with front-panel connector directly coupled to the tube grid. Phase modulation may be accomplished through a front-panel connector capacitively coupled to the tube helix. (Alfred Electronics, Dept Sci427, 897 Commercial St., Palo Alto, Calif.)

■ **TWO-COORDINATE COMPARATOR** accommodates plates and film to 10 by 10 in. with a measurable area 9 by 9 in. Range in the x-coordinate is 265 mm and in the y-coordinate is 250 mm with direct-reading accuracy said to be $\pm 1 \mu$ in both coordinates. Plate image and measuring mark are projected on a screen at magnification 22. The top stage of the comparator rotates through 360 deg and provides angular measurement to 20 sec by means of a vernier. Available as accessories are motor drive, analog-to-digital converts for automatic read-out and film-handling devices. (David W. Mann, Inc., Dept. Sci436, Lincoln, Mass.)

■ **PHOTOGRAPHIC RECORDER** is a 2¼ by 2¼ in. frame camera with eight selectable frame rates up to 80/per second. The shutter is a focal-plane rotating-disc type with opening adjustable from 2 to 90 deg. A shutter synchronization pulse is provided coincident within ±1 deg with exposure 100-cy/sec pulses and an elapsed-time code for continuously running film. Registration accuracy is said to be ±0.001 in. (Benson-Lehner Corp., Dept. Sci428, 1860 Franklin St., Santa Monica, Calif.)

■ **RANDOM-WAVE VIBRATION TESTING SYSTEM** is designed for standardized repetitive testing and push-button operation over the frequency range 5 to 10,000 cy/sec. Peak random force is 2500 lb and peak sine-wave vector force is 1500 lb when used with the manufacturer's model A-174 shaker. No impedance changing or manual power-factor correction is required over the specified range. (Ling Electronics Inc., Dept. Sci424, Culver City, Calif.)

■ **NOISE SOURCE** uses a restrictive element heated to 2200°K to generate sufficient noise power to permit noise-figure measurements to 10 db. Nominal available noise temperature from 2000° to 2400°K can be read on a panel meter with accuracy said to be ±2 percent. A single tuning element furnishes a fixed range of 2 to 500 Mcy/sec or may be tuned to extend the range to 1000 Mcy/sec. An interchangeable noise head extends the range downward to 1 kcy/sec. (Kay Electric Co., Dept. Sci426, Maple Ave., Pine Brook, N.J.)

■ **ANALOG COMPUTER** is designed to solve Fourier integrals especially for application to determination of far fields of antennas. Amplitude and phase input functions are plotted on graph paper for presentation to the computer. The functions are read photoelectrically, passed through a pulse-position-to-voltage converter and then to computing circuitry. Integration can be observed on a d-c oscilloscope or can be recorded by accessory equipment available from the manufacturer. (Scientific-Atlanta Inc., Dept Sci433, Atlanta, Ga.)

■ **DIGITAL CLOCK** provides time data for each second of the day through multiple relay contacts that can be wired to produce several staircase and decimal outputs simultaneously, or a binary-coded-decimal output. An in-line display with 1 sec resolution to 24 hr is also provided. Time information may be recorded on demand. A memory circuit holds the time display up to 0.9 sec for completion of external recording so that



A COMPLETE LINE OF TISSUE CULTURE APPARATUS

Including many items described for the first time in our Tissue Culture Bulletin TC-3. Among them:

Dual Tissue Grinder. 2-stage grinding permits mincing and homogenization in one tube with one operation. Conical section does heavy grinding; product is homogenized as it is forced up past cylindrical section. Capacities range from 5 to 50 ml.

Motor Support and Cooling Chamber Assembly. Keeps samples cold to preserve enzyme activity. Securely holds homogenizing tube in an environment of crushed ice or other coolant while providing for up and down movement of the pestle within the tube.

Carrel Flask. High quality windows allow optical observation through top and bottom surfaces with minimum distortion. Two diameters—35 mm. and 50 mm.

Porter Flask. Basically the same as the Carrel Flask except that it has a long, horizontal neck—35 mm. diameter.

T-Flask. Inside bottom surfaces flat to allow large number of cultures to be planted and grown evenly. Approximate floor area—9, 15, 30, and 60 cm.²

Why not write for a free copy of Bulletin TC-3?

KONTES GLASS COMPANY



Vineland, New Jersey

First Choice For Quality Technical Glassware

Midwest Distributor: Research Apparatus, Inc., Wauconda, Ill.

NON-MECHANICAL and FULLY PORTABLE Refrigerator for storage at -320°F .

LINDE's fully portable LNR-25B Liquid Nitrogen Refrigerator is the most reliable cold storage unit in existence. This rugged stainless steel container has no mechanical operating parts and thus is essentially maintenance-free—eliminates damaged samples caused by power failures.

It weighs only 60 lbs. empty, yet holds 28.5 liters of liquid nitrogen and 392 cu. inches of stored samples. A special LINDE insulation holds evaporation loss to only 3% a day. On a single charge of nitrogen, it will keep samples at -320°F . for 34 days, directly immersed in the liquid, or for 23 days in sealed tubular baskets suspended in the liquid. The large-diameter neck tube permits quick and easy access to the interior.

Linde Company manufactures a full line of containers (including the $16\frac{1}{2}$ cu. ft. storage capacity LNR-640 Refrigerator), accessories and other cryogenics equipment for the storage and handling of liquefied atmospheric gases. For information on the LNR-25B Refrigerator or other equipment, mail the coupon.

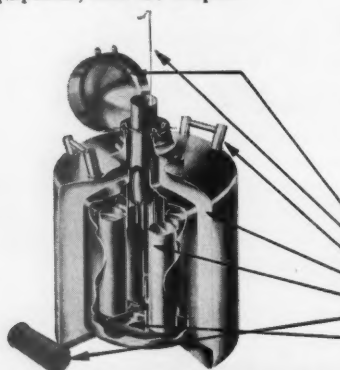


Typical uses:

- preservation of enzymes, hormones, proteins
- pharmaceutical and chemical research
- storage of bacteria cultures without laborious transplanting
- preservation of cancer cells for research
- shrink fitting small metal production parts
- cold storage of aluminum rivets and metallurgical samples
- immediate freezing of animal glands

CONSTRUCTION

Cutaway shows interior arrangement of storage baskets in the LINDE LNR-25B and its construction. Baskets are easily and quickly withdrawn through wide-entrance tube. All-stainless welded construction and superior insulation make it both portable and durable.



- Hinged Cap
- Basket Support Rod
- Lifting Handle
- Special LINDE Insulation
- Product Storage Basket
- Removable Neck Tube
- Basket Spacer

Linde Company, Division of Union Carbide Corporation Dept. SC-033
30 East 42nd Street, New York 17, N. Y.

Please send me complete information on

- ☐ the LNR-25B refrigerator
☐ other equipment for liquefied atmospheric gases
(please specify) _____

Name _____

Firm Name _____

Address _____

City _____ Zone _____ State _____

Linde
TRADE-MARK

**UNION
CARBIDE**

"Linde" and "Union Carbide" are registered trademarks of Union Carbide Corporation.

the record shows the exact time at which data was taken. Operation is from an external 1-sec pulse train or an optional internal line-frequency divider or crystal-controlled time base. (Dymec Division of Hewlett-Packard Co., Dept. Sci459, 395 Page Mill Rd., Palo Alto, Calif.)

■ **MANIPULATOR** for moving objects in vacuum or in controlled atmospheres uses double-pumped vacuum seals to permit operation to pressures as low as 10^{-6} mm-Hg. The 3-ft, stainless-steel shaft of the device can be moved in and out of the chamber and rotated and can be turned through a 90 deg cone. Positive acting parallel jaws are controlled by a pistol-grip handle. (Scientific Engineering Laboratories, Inc., Dept. Sci416, 1510 Sixth St., Berkeley 10, Calif.)

■ **SHIELDING CONTAINERS** are fillable, hollow blocks of Fiberglas construction that can be filled in place with fluid or semifluid shielding materials. Two basic sizes and three compound sizes are offered. The compound blocks interlock to prevent radiation leakage. (General Nuclear Corp., Dept Sci419, 5506 Connecticut Ave., NW, Washington 15, D.C.)

■ **JERKMETER** is available to measure rate-of-change of linear and angular acceleration. Models are available with full-scale acceleration ranges from ± 1 to ± 30 grav and with full-scale jerk ranges from ± 0.5 to ± 20 grav/sec. Full-scale output is ± 7.5 volts d-c. Resolution, linearity, and hysteresis are said to be 0.1 percent or better and accuracy to be ± 0.1 percent. (Donner Scientific Co., Dept Sci432, Concord, Calif.)

■ **TORQUE GAGE** is a hand-held device available in clockwise, counterclockwise, or bidirectional models in ranges from 0.005 to 40 oz-in. and 2 to 2400 gm-cm. Shift diameters up to $\frac{1}{4}$ in. are accommodated. The device retains the maximum torque reading. Accuracy is said to be ± 5 percent with ± 2 percent accuracy available on special order. (Waters Manufacturing Co., Inc., Dept. Sci434, Wayland, Mass.)

■ **ACOUSTIC NOISE GENERATOR** uses an electromechanical transducer of moving-coil type to produce 163 ± 3 db of random noise and up to 170 db at discrete frequencies. Higher output may be obtained for limited periods with attendant risk of damage. Quickly interchangeable parts are a feature of the design. Frequency range is 20 to 2100 cy/sec. Random noise input power is 3 kw. Nominal impedance is 1 ohm. (Avco Research and Advanced Development Div., Dept. Sci440, 201 Lowell St., Wilmington, Mass.)

■ **ALUMINUM WIRE** for use at high temperatures in nuclear-radiation environments is boron-free and is insulated with boron-free ceramic. The wire is designed for continuous operation at 1000°F. Voltage rating is 400 volts and insulation resistance at 1000°F is 1.4×10^7 ohm. The wire is flexible enough to be wound around a mandrel five times its own diameter. (Technical Industries Corp., Dept. Sci439, 389 North Fair Oaks Ave., Pasadena, Calif.)

■ **ULTRAMICRO ANALYTICAL SYSTEM** employs liquid reagents contained in a series of squeeze bottles, each fitted with a calibrated polyethylene tip that serves as a pipette. The precise amount of reagent for analysis is added simply by squeezing the bottle. The complete system consists of a miniature spectrophotometer, a microtitrator, a centrifuge, and sets of reagents for specific clinical tests. (Spinco Div., Beckman Instruments Inc., Dept. Sci444, Stanford Industrial Park, Palo Alto, Calif.)

■ **WIRE STRIPPER** uses parallel heating elements to sever insulation for removal, leaving the wire free of nicks or cuts. Heat is adjustable for high- or low-melting materials. A single model strips wire larger than 12 AWG and smaller than 36 AWG. The tool may be hand held or used as a bench tool. (Western Electric Products Co., Dept. Sci445, 655 Colman St., Altadena, Calif.)

■ **TENSILE TESTING INSTRUMENT** is designed for use in hot cells for studying physical properties of irradiated materials. The straining unit is located within the cell while controls are operated outside. Full-scale range is adjustable from 2 gm to 10,000 lb. Remote operation is provided for grips, calibration, speed change, extensometer, and selection of load range. (Instron Engineering Corp., Dept. Sci446, 2500 Washington St., Canton, Mass.)

■ **PORTABLE SPECTROSCOPE** displays side by side spectra of an unknown solution and of a reference solution. Wavelength is read to ± 5 Å on a projected scale. Dispersion element is a replica grating ruled 31,070 lines/in. Dispersion is 55 Å/mm. Lines as close as 3 Å are said to be resolved. Sample tubes are enclosed in water jackets and sealed by lucite plugs carrying pairs of platinum electrodes. Operation is on 115-volt, 60-cy/sec power with maximum consumption 250 watts. (Fisher Scientific Co., Dept. Sci458, 717 Forbes St., Pittsburgh 19, Pa.)

■ **MAGNETIC-TAPE SEARCH UNIT** compares the timing or index track of a magnetic tape with switches set to designate the beginning and end of tape sections of interest. Upon location of



THE FERRANTI-SHIRLEY CONE-PLATE VISCOMETER

This advanced instrument enables the flow behavior of simple or complex fluids to be examined and evaluated with totally new standards of accuracy and precision. The instrument is particularly useful in handling the complex non-Newtonian fluids. Methods long used for characterizing these fluids have been subject to error. The cone-plate principle affords a constant rate of shear, speed accuracy within 0.2%; cone speeds continuously variable so as to give a shear rate range from 2 to 20,000 reciprocal sec.⁻¹; direct reading of speed, full torque at all speeds, five sensitivities by selector switch.

A programmed control unit for use in conjunction with an X-Y recorder to permit automatic plotting of characteristics is also available.

Investigate this advanced viscometer and the new principle that brings a greater degree of accuracy to the examination of fluids under today's more critical and exacting requirements, both in laboratory and production control applications.

Write for literature.



FERRANTI ELECTRIC, INC.
ELECTRONICS DIVISION

95 MADISON AVENUE

HEMPSTEAD, N. Y.

these sections, control signals are generated to effect printout or other desired action. The unit is composed of transistorized plug-in modules. (Vitro Laboratories, Dept. Sci443, 200 Pleasant Valley Way, West Orange, N.J.)

■ **TRUE AIR-SPEED COMPUTER** consists of a force-balance Mach transducer, a platinum-resistance temperature sensor, passive resistance network, and a follow-up servo. Three operating ranges and accuracies for various applications are available. (Servomechanisms, Inc., Dept. Sci430, 12500 Aviation Blvd., Hawthorne, Calif.)

■ **BOTTOM-FILLING ATTACHMENT** for automatic filling machine eliminates or minimizes foaming, permitting faster filling. With the attachment, filling nozzles are automatically lowered into the containers and are raised, as the liquid level rises, at a rate that may be adjusted to coincidence with the filling rate. (National Instrument Co., Inc., Dept. Sci454, 2701 Rockwood Ave., Baltimore, Md.)

■ **GAMMA-RAY SENSITOMETER** uses cobalt-60 foil to give industrial x-ray film controlled exposure in tests of sensitivity. Elevators bring the film samples

in cassettes into position for exposure in the lead chamber in which the sources are stored. Four sources of different radiation activities are used. (Eastman Kodak Co., Dept. Sci441, Rochester, N.Y.)

■ **WIND TUNNEL** is a portable model designed especially for educational application. In operation, the tunnel uses a 2500-lb/in.² dry-gas source with running time as high as 4 minutes from a standard 2-ft³ nitrogen cylinder. Continuous adjustment in the range Mach 1 to 4 is provided. Wind-tunnel and free-jet test section configurations are interchangeable. A schlieren system is provided for visualization of flow phenomena. Its 4-in. square ground-glass screen can be photographed without special camera equipment. An inlet air heater that eliminates ambient moisture condensation is thermostatically controlled. Operation is on 115 volts a-c. (Amrad Inc., Dept. Sci456, Box 254, Sewanee, Tenn.)

■ **TORQUE PICKUPS** are available for full-scale ranges from 50 to 250 in.-oz full scale with useful speed ranges up to 10,000 rev/min. Full-scale output is 2 mv/volt. Thermoelectric voltages are said to be less than 2 μ v peak-to-peak, at 10,000 rev/min. (Lebow Associates, Dept. Sci431, 941 West Warren, Detroit, Mich.)

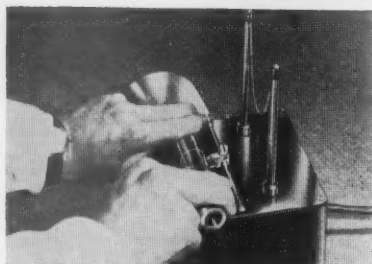
■ **RIPPLE TANK** provides projected images of wave crests and troughs 6 to 8 ft in diameter. Bottom of the tank is a 3.5-in. condenser lens. A built-in variable speed stroboscopic interrupter permits phenomena to be displayed in motion, slow motion, or at rest. (Ealing Corp., Dept. Sci437, 40 University Rd., Cambridge, Mass.)

■ **MECHANICAL PRESSURE-VACUUM PUMP** is a compact unit weighing 5 lb, including its motor. The pump has a free-air capacity of 0.3 ft³/min and will produce 17 in.-Hg vacuum or 20 lb/in.² pressure. Pumping mechanism is an aluminum piston with graphite sealing rings. (Gelman Instrument Co., Dept. Sci438, P.O. Box 86, Chelsea, Mich.)

■ **HIGH-PRESSURE SYSTEM**, a portable unit for testing missile components, includes a diaphragm gas compressor and a 1/2-ft³ accumulator, both rated at 10,000 lb/in.² gage. Compressor capacity is 4 ft³/min, standard, at 2000 lb/in.² gage. Air, nitrogen, and helium can be handled. (Pressure Products Industries, Inc., Dept. Sci442, Hatboro, Pa.)

■ **STERILIZATION INDICATOR** is a pressure-sensitive paper tape imprinted with a colorless chemical substance so that when subjected to a specified standard sterilizing cycle the word *sterile* ap-

A Safe, Convenient Means of Cutting Hard or Soft Glass, up to 3" diameter



Electrothermal[®] GLASS TUBE CUTTER

Ideal for the laboratory and workshop

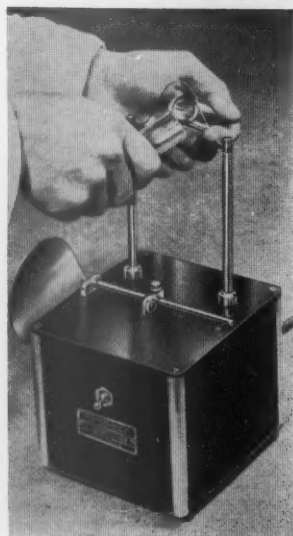
No special skill is required. The tube is merely rotated against the cutting wheel and the resulting scratch mark is then held against the hot wire, localized heat causing the tube to part neatly. An adjustable backstop makes sure that the scratch is cut accurately around the circumference of the tube.

To provide extra low voltage for heating the wire, the equipment contains a double-wound transformer fitted, for safety, with an earthed screen between primary and secondary.

On the front of the top plate are mounted the guide, backstop, and cutting wheel holder. Six standard cutting wheels are provided in one unit, and are rotated out of the way as they become blunt. They can be replaced easily. On the top-plate are two pillars, between which the replaceable nickel/chrome wire is connected.

The apparatus is supplied for use on 120 volts, with 20 feet of 27 S.W.G. nickel/chrome wire and a set of six cutting wheels.

PRICE	
Cat. No. S-63762 GLASS TUBE CUTTER, COMPLETE	\$72.50
Cat. No. S-63763 REPLACEMENT WIRE, PER 20' LENGTH	.60
Cat. No. S-63764 REPLACEMENT CUTTING WHEELS, SET	1.35





STANDARD SCIENTIFIC
Supply Corp.

808 BROADWAY
NEW YORK 3, N.Y.

LABORATORY
APPARATUS
REAGENTS
AND
CHEMICALS

NEW universal shield with "built-in" versatility

Designed for use with most counting systems, the Universal Shield can help you solve a variety of shielding problems. The Shield's 12-inch high steel walled center tube has a 4 1/8 inch diameter and can readily accommodate most standard detectors, scintillation probes and crystals.

SPECIAL CONSTRUCTION FEATURES:

One and one-half inches of lead have been cast between 5/16 inch steel inner and outer walls to provide the shielding equivalent of almost two inches of lead. All lead is steel incased to prevent deformation.

Removable top shield contains two individually removable two-inch deep concentric lead plugs.

Bottom shielding is provided by two two-inch thick lead plugs which may be replaced with a low z material to further reduce backscatter in critical counting problems.

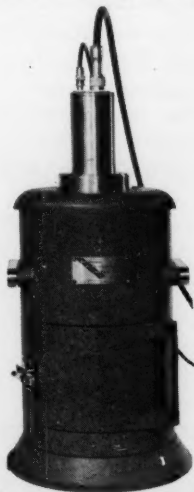
Right-hand door has latch-type handle and 4 inch by 4 inch opening.

Step-type seals on door and plugs.

Space-saving, slide-in carrying handles.

OPTIONAL CAST ALUMINUM BASE AVAILABLE:

Extra bottom shielding or electronic circuitry can be housed in optional cast aluminum base which has a removable front panel for mounting controls, connectors, etc.



DESIGNERS AND DEVELOPERS OF SCIENTIFIC EQUIPMENT

We offer design and construction facilities for your special equipment needs. If you have any equipment design problems, write or, better yet, call us today. We may be able to help you.

\$348
F.O.B. Chicago

INSTRUMENT AND DEVELOPMENT PRODUCTS CO., INC., 355 West 109th Place
Chicago 28, Ill. WAterfall 8-1221



Supplying
Your
Complete

LABORATORY NEEDS..

● Since 1931, New York Laboratory Supply Co., Inc., has been serving industry with all their laboratory requirements. This has not been an easy job—it has been a challenge—a challenge we meet and conquer every day. Below is listed a few of the many instruments and apparatus we carry:

Balances & Weights

Baths

Calorimeters

Centrifuges & Accessories

Chemicals, Laboratory

Colorimeters

Crushers & Mills

Distilling Apparatus

Filter Papers

Furnaces

Gas Analysis Apparatus

Glassware

Heaters & Hotplates

Hydrogen-Ion Equipment

Hydrometers

Incubators

Metallographic Equipment

Microscopes & Accessories

Nitrogen Determination Equip.

Ovens

Petroleum Testing Equip.

Porcelain Ware

Powerstats

Pumps

Refractometers

Shakers

Sieves

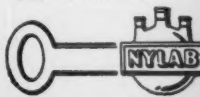
Spectrophotometers

Stirrers—Mechanical & Magnetic

Thermometers, etc.

Let us help you efficiently solve your laboratory instrument and apparatus problems. Call on us, we will be glad to help you.

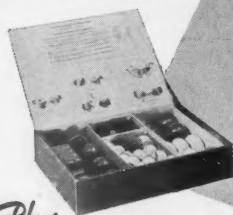
KEY TO ALL
LABORATORY SUPPLIES



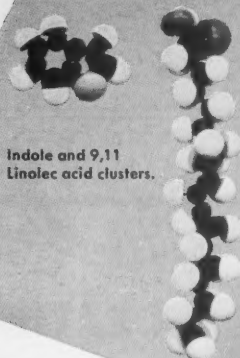
NEW YORK
Laboratory Supply
COMPANY, INC.

76 Varick Street, New York 13, N. Y.
Telephone: CAnal 6-6504

Godfrey MOLECULAR MODEL KIT



Indole and 9,11
Linoleic acid clusters.



Plus

NEW SUPPLEMENTARY MODELS for Researchers, Teachers, Students

Godfrey molecular models give best representation of van der Waals' and covalent radii—a true picture of steric hindrance. Models of small ring compounds and bicyclic compounds easily made. Show flexibility and resilience of actual molecules.

NEW Supplementary Atoms: 15 new atoms just designed—35 elements may be represented in 65 valence states, using only 26 different atoms.

Write for Full Details



BRONWILL SCIENTIFIC
A Division of Will Corporation

3900 Russell Street • Box 3927, Rochester 10, N. Y.

GORDON RESEARCH CONFERENCES, 1960

Request for Application Forms

To: W. George Parks, Director
Gordon Research Conferences
Department of Chemistry
University of Rhode Island
Kingston, R.I.

Please send me application forms for attendance
at the Gordon Research Conference on

Name

Address

City Zone ...

State



Electronic THERMOMETER

THERMISTOR TYPE

- **RAPID ...**
Read temperature
in seconds
- **ACCURATE ...**
 $\pm 1/2\%$ of scale
range
- **RANGES ...**
From -35
to $+150^{\circ}\text{C}$.
- **DIRECT
READING ...**
In $^{\circ}\text{C}$. and $^{\circ}\text{F}$.
- **REMOTE
READ-
ING ...**
Leads to
1000 feet
- **LOW
COST ...**
Priced from \$72.00
- **STABLE ...**
Mercury cell battery models, regulated line operated models
- **PROBES ...**
Interchangeable and special for human, animal, laboratory use
For Thermometer bulletin and other Tri-R Instruments write Dept. S36



TRI-R INSTRUMENTS

Developers of Electronic and Mechanical Instruments for Scientific Research

144-13 JAMAICA AVENUE, JAMAICA 35, N. Y.

ZOOGEOGRAPHY

Editor CARL L. HUBBS

To the Memory of Charles Darwin
and Alfred Russel Wallace

AAAS Symposium Volume No. 51
510+x pp., 115 illus., 13 tables, 6x9, author index
of scientific names, references, cloth

AAAS members' cash orders \$10.50, Retail \$12.00

August 1957 Stanford Symposium:
The Origins and Affinities of the
Land and Freshwater Fauna
of Western North America

December 1957 Indianapolis Symposium:
Some Unsolved Problems in Biology, 1957:
Geographic Distribution of
Contemporary Organisms

- ... a vast storehouse of information,
- ... a kinetic approach, concerned with processes
and explanations
- ... great diversity in: groups of organisms—areas
covered—topics stressed—angle of approach

English Agents: Bailey Bros. & Swinfen, Ltd.
Hyde House, West Central Street, London W.C.1

**American Association for the Advancement
of Science**

1515 Massachusetts Avenue, NW, Washington 5, D.C.

pears. Activation requires an autoclaving temperature of 250°F for at least 15 minutes. Accidental activation under atmospheric conditions is said to be impossible. (Professional Tape Co., Inc., Dept. Sci453, 355 Burlington Ave., Riverside, Ill.)

■ **MERCURY COLLECTOR** is said to pick up individual globules of spilled mercury in the pores of a foamed-plastic pad when the latter is pressed firmly against the surface on which the mercury has been spilled. The collected mercury is released when the pad, carried in the screw lid of a container, is screwed back on the container. (Bel-Art Products, Dept. Sci448, Pequannock, N.J.)

■ **POWER SUPPLY** for test and measurement of infrared photoconductors is battery operated with 50, 100, 500 volt ranges. Current ranges are 25, 100, 250, 1000 μ a. A microammeter and a voltmeter of ± 1 percent accuracy permit measurement of detector resistance under conditions of use. (Infrared Standards Laboratory, Dept. Sci451, 10555 Magnolia Ave., Riverside, Calif.)

■ **DIFFERENTIAL-TRANSFORMER AMPLIFIER** furnishes outputs suitable for driving cathode-ray oscilloscopes, pen recorders, or light-beam galvanometer recorders. Frequency response is flat from 0 to 200 cy/sec and useful to 500 cy/sec. Accuracy is said to be ± 2 percent with maximum resolution of 5 μ in. of core displacement. Excitation supply is self-contained. (Daytronic Corp., Dept. Sci452, 225 S. Jefferson St., Dayton 2, Ohio)

■ **RADIOMETER** measures temperature of remote surfaces from 120°F upward. Area measured is typically 1 in.² at a distance of 40 in.; area increases approximately as the distance. Two models are available. One has a servo drive for the null-balancing measuring system; the other is manually balanced. Either may be calibrated for emissivity of the surfaces being measured. (Williamson Development Co., Inc., Dept. Sci455, 317 Main St., West Concord, Mass.)

■ **COMPLEX-RATIO BRIDGE** measures in-phase and quadrature voltage ratios of three- or four-terminal networks. Frequency ranges of two models are 30 to 1000 cy/sec and 50 to 3000 cy/sec, respectively. Transformation ratios are read from digital switch dials in terms of rectangular coordinates, tangent, or phase angle. Maximum accuracy of in-phase ratio is said to be ± 0.001 percent. (Gertsch Products, Inc., Dept. Sci457, 3211 S. La Cienega Blvd., Los Angeles 16, Calif.)

JOSHUA STERN

National Bureau of Standards,
Washington, D.C.

18 MARCH 1960

LOOK TO T/A FOR THE FINEST QUALITY NUCLEAR INSTRUMENTATION



SM-10 SCANNING
SPECTROMETER SYSTEM

ANALYTICAL SYSTEMS and COUNTING INSTRUMENTS

- Pulse Height Analyzers and Spectrometers
- Decade and Binary Scalers
- Log and Linear Rateometers
- Linear Amplifiers
- Absorber Sets — Timers
- H.V. Power Supplies

LEAD SHIELDS

T/A specializes in lead shields and has developed over 30 commercial versions. Let us help you with your lead shield requirements!

- Vertical and Horizontal Lead Shields
- Multi-Purpose GM & Scintillation-Type Shields
- Well-Counting Lead Shields
- Source Storage and Shipping Casks



LS-6 VERTICAL LEAD SHIELD



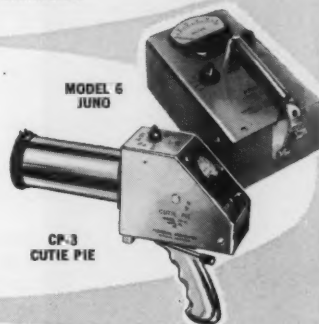
SCINTILLATION DETECTORS

T/A offers an extremely versatile line of scintillation detectors and accessories for research, medical, and industrial application.

- Solid and Well-Type Crystals
- Proportional or Cathode Follower Preamplifiers
- Nose Shields and Collimators

PORTABLE SURVEY INSTRUMENTS

The T/A Juno and Cutie Pie are the most widely used survey meters in the world.



MODEL 6
JUNO

CP-3
CUTIE PIE

HEALTH PHYSICS

T/A has continually led in the development of personnel monitors for the automatic detection and measurement of radiation contamination.

- Beta-Gamma Hand & Foot Monitor (Illus. at left)
- Portal Monitor (Illus. at right)
- Alpha Hand Monitors
- Laundry Monitors



Write for Catalog

"INSTRUMENTATION FOR NUCLEAR RESEARCH"

T

ECHNICAL ASSOCIATES

140 West Providencia Avenue • Burbank, California

NOW...first electrostatic generators for industrial use that can give several kilowatts at up to 600,000 volts dc

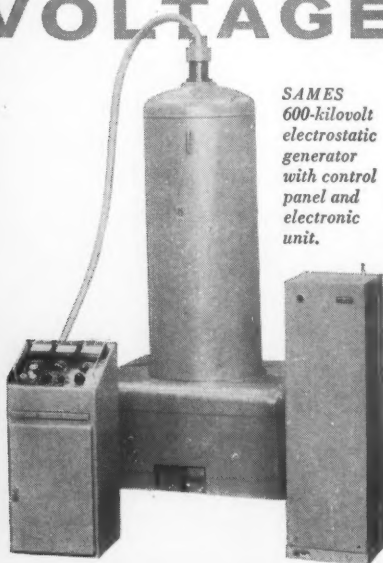
The complete line of "Sames" electrostatic generators—the first practical industrial electrostatic power supplies—are now available in the U.S. from Sorensen & Company. They supply from 50 to 600 kilovolts dc at substantial amounts of power (2400 watts for the 600 kv model).

The Sames generators (so-called from their manufacturer, Societe Anonyme de Machines Electrostatiques, Grenoble, France) are extremely compact and safe compared to transformer-rectifier-filter-type supplies in similar kilovolt ranges. The electrostatic generators are available in highly stabilized models supplying 50, 100, 150 and 600 kilovolts that are particularly suitable for electron-microscopy and many critical nuclear physics applications. Medium stability models with outputs of 50, 80, 100, 140, 150, 250, 300, and 600 kilovolts, have found wide application in Europe for testing cable insulation, alternator windings and other dielectrics, electrostatic flocking, painting and particle precipitation, electron and nuclear particle accelerators and similar applications.

Write for new product data on Sames electrostatic generators, and find out about the complete line of Sorensen h-v equipment.

S.36R

HIGH VOLTAGE



SAMES
600-kilovolt
electrostatic
generator
with control
panel and
electronic
unit.

SORENSEN & COMPANY, INC.
Richards Avenue, South Norwalk, Conn.
A SUBSIDIARY OF RAYTHEON COMPANY

... the widest line lets you make the wisest choice



Visit the Sorensen Booth at the IRE Show—March 21-24

Letters

(Continued from 796)

dose and cancer incidence in the dose range of known carcinogenicity. The question is whether natural radiation plus fallout brings us into that range, and I see nothing in Blum's work that bears on this crucial point.

JOHN W. BERG
Memorial Center for Cancer and Allied Diseases, New York, New York

References

1. H. F. Blum, *Carcinogenesis by Ultraviolet Light* (Princeton Univ. Press, Princeton, N.J., 1959).
2. —, H. G. Grady, J. S. Kirby-Smith, J. Natl. Cancer Inst. 3, 83 (1943).
3. H. F. Blum, *ibid.* 11, 463 (1950).

Before answering Berg's specific criticisms may I point out that my article does not state, as he implies, that there is no threshold for radiation carcinogenesis, but only that it is infeasible to demonstrate one experimentally. As I say in that article, and elsewhere (1, 2), the analysis of data on the induction of cancer by ultraviolet light suggests that a threshold exists but does not permit a value to be set for that threshold, although it must be very low. The argument in the article under discussion is based on the good agreement between extensive experimental data and a quantitative model that is compatible with the concept of acceleration of cancer growth rate under conditions of repeated dosage. Certain extrapolations are made in the article on the basis of this model, but no discussion of the experiments or the model itself was attempted in the brief space available. In objecting to my extrapolations Berg seems to disregard, or to be unaware of, the consistent agreement of the model which I use in my extrapolations with the whole of these data, although he cites a reference in which both data and model are discussed at length (1).

Although many of Berg's criticisms are directed at points in the basic structure rather than at the content of this particular article, it seems necessary to answer them here. I shall attempt to do so in more or less the order he presents them. Figure 1 in the article is based on the aforementioned model and does not purport to represent specific experiments; it was designed to illustrate the extrapolation to conditions near the end of the life span of the animals, where experiments must necessarily be untrustworthy or infeasible. Curve 1 in this figure obviously represents an extrapolation, since it refers to a time when most of the animals would have been dead. Berg seems to have taken this figure more literally than was intended, since he raises the objection that I do not have experi-

mental data for this particular curve. Citing one of the papers in which some of these data are described (3), Berg writes, "the third dose level is treated partly by extrapolation." Apparently Berg is referring to data taken from an experiment in which a dose level which would correspond approximately to curve 3 in Fig. 1 was used. The extrapolation in this case was to the 50-percent incidence level, from measurements representing lower incidences; this extrapolation was made for purposes of comparison, since a more complete curve could not be obtained for this dosage because of normal mortality. So the extrapolation has a better basis than might be inferred from Berg's statement. Actually, the experiments cover rather well the dosage range that it is feasible to study with the animals in question. The fact that one cannot obtain more complete coverage might in itself indicate the infeasibility of setting a threshold, since we can never be sure that cancers which have not come to detectable size before the death of the animals are not present.

Berg does not point out that the validity of the extrapolation represented in Fig. 1 rests on the finding that within the experimental range the shape and slope of the distribution curves does not change with dose or other factors; the reliability of this finding is treated in a later publication (4) than the one Berg cites—one which contains further data. The constancy of the incidence distribution curve is illustrated graphically in Fig. 31 of (1), where points obtained from over 600 mice are brought into relationship on a composite plot. The curves in Fig. 1 of the article in *Science* are based on this relationship, their positions on the abscissa corresponding to Eq. 1. An important point in the evaluation of the model is that it fits other data in which doses were interrupted (see 1). If all these data are taken into consideration in terms of the model, I think there is ample justification for the extrapolation that is made in the article under discussion.

Berg is reproachful because studies of the earlier stages of development of cancers were not made with the microscope. But has he taken into consideration the quantitative aspects of such a study? In our experiment the end point was the gross appearance of a tumor of a given volume. Obviously, it would be a great advantage to have reliable data on the growth at earlier, microscopic stages if it were feasible to obtain them. But the time of tumor appearance varies widely among the animals of an identically treated population (see Fig. 1), and one does not know in advance which animal is going to be the first to display a tumor, or how to place any of the animals in



5:10 P.M.: Beginning of a difficult, time-consuming analysis:

Cary Spectrophotometers Record Spectra Around the Clock...unattended

...with the Program Control Accessory

This useful accessory enables CARY SPECTROPHOTOMETERS to automatically repeat spectral scans at predetermined time intervals. Scans may be repeated at intervals ranging from as little as 10 minutes to 24 hours, and may be spaced in any desired program.

Some laboratories almost double the usefulness of their CARY SPECTROPHOTOMETERS by using them during the day on routine work, then setting them up with the Program Control for automatic analysis during the night.

However, automatic programming is just one feature which demonstrates the unmatched versatility of CARY SPECTROPHOTOMETERS. The wide wavelength range, high resolution, low stray light, plus the availability of a number of useful accessories for other measurement techniques, enable Cary Instruments to serve a wide analytical field.

Complete information on these versatile instruments is yours for the asking. Write for Data File E-13-20



RECORDING SPECTROPHOTOMETERS

APPLIED PHYSICS CORPORATION • 2724 SOUTH PECK ROAD • MONROVIA, CALIFORNIA



TOO MANY VARIABLES?

It's time to draw a line.
Straighten out your cleaning
problems with

HAEMO-SOL

There's nothing like Haemo-Sol's unique cleansing power and positive rinsing . . . it's completely safe! No etching! No corroding of metal parts! Immediate Haemo-Sol bath for valuable volumetric and optical equipment prevents soil etching!

Haemo-Sol guarantees clean laboratory glassware and apparatus—

- removes the full range of laboratory soils
- effectively digests protenoid materials . . . other types of polymeric materials
- assures free draining pipets . . . burets
- gives sparkling clear surfaces for quartz and glass absorption cells
- provides chemically clean reaction and titration flasks
- leaves the clean surfaces that are a must for the smooth operation of fractionating columns and other pieces of laboratory equipment.

And, just as important as its unique cleaning power, is Haemo-Sol's high solubility and powerful solubilizing action. Haemo-Sol washed glassware rinses completely clean . . . nothing remains behind but a chemically clean, free draining glass surface.



Write
TODAY for
Sample and
Literature.

Distributed by

MEINECKE & CO., INC.

225 Varick Street
New York 14



order with respect to the time at which a tumor will appear. We thus face a dilemma; if we wait until a tumor appears we have no measurements of microscopic stages; on the other hand, if we sacrifice the animal before a tumor appears we can have no idea when the tumor would have become microscopically observable had the animal been allowed to survive. If we attempt successive biopsies we are certain to interfere with tumor development, and besides we would not know where to make them. Gross observation shows that more than one tumor may develop on the irradiated area, and that the tumor we ultimately measure is the one of these that grows the fastest (for example, see Fig. 50 in 1). It is also to be noted that good many of the tumors are mixed (sarcoma and carcinoma), indicating more than one site of origin (5). Altogether, the attempt to search out the course of tumor development by microscopic study would seem to have somewhat the aspect of a search for a needle in a haystack.

The decision as to whether it would be advisable to attempt microscopic studies at all—for Berg would apparently attempt them in spite of these difficulties—must depend upon extrapolation back from the time of appearance of tumors. The extrapolation must depend upon the kind of mathematical model one uses. Berg reaches the conclusion that such a study should have been made by means of an extrapolation; this extrapolation, though vaguely stated, would seem to be based on the idea that the tumor has been growing for some time at a constant relative rate. Berg uses the estimates of terminal growth rate which I have made; but if he will examine the original article in which these rate measurements are described (6) I think he will find ample indication of the uncertainties involved in such an extrapolation and of its obvious inapplicability. Moreover, the model which we have found to describe the data indicates an acceleration of the relative growth rate of the tumor, in which case the measured terminal rate could not be a valid index of growth at earlier stages when growth must have been slower. From the model it appears that although one may essay to extrapolate to the initial volume at the time the first dose of radiation is given (1, 7), extrapolation to intermediate volumes is not possible without information we do not have (1, 8).

Berg attempts to demonstrate the existence of a threshold for ultraviolet carcinogenesis on the basis of an interpretation of certain of my data from experiments in which the doses of ultraviolet light were interrupted. He apparently obtained his data by interpolation in curves published in an article about

VAPOR CHROMATOGRAPHY

especially for
FATTY ACID and LIPIDE RESEARCH

PACKINGS and COATINGS

EGS and EGA on acid-washed "Chromosorb W"
Sharp separation of fatty acid esters
Very low bleed rates
Good flow rates
PRETESTED: Each lot must meet our rigorous standards

COLUMNS

Completely packed and tested
Ready for use. Guaranteed to meet specifications
Real time and trouble savers.

STANDARDS

Fatty Acids and Derivatives
We aim at 99.8% purity.
ODD-CARBON fatty acids and esters, C₉-C₂₁, 99.8%
ALSO: Common saturated fatty acids, esters, alcohols, bromides, and chlorides. alpha-Hydroxy acids. Oleate, linoleate, palmitoleate.

SERVICES

Fatty acid Ester Analysis
Preparative Chromatography
Consultation on your problems

GENERAL CONTRACT RESEARCH,
DEVELOPMENT, and TESTING

Send for Brochure

Applied Science Laboratories, Inc.
Dept. K, 140 N. Barnard St.
State College, Pa., AD 8-0021

WATER FOR INDUSTRY

Jack B. Graham and
Meredith F. Burrill, Eds.

AAAS Symposium Volume No. 45

CONTENTS

The Available Water Supply
Water Requirements
Geographic Distribution of Manufacturing
Water and Steel: Fairless Works Water Supply
The Treatment and Disposal of Wastes in the Atomic Energy Industry
Water Supply and Waste Disposal Requirements for Industry
Antipollution Legislation and Technical Problems in Water Pollution Abatement
Correction of a Fluvial Delinquent: The Schuylkill River
Water in the Future
Discussion

6 x 9 in., 141 pages, 18 illus., index, cloth, 1956, \$3.75. AAAS members' cash price, \$3.25.

British Agents: Bailey Bros. & Swinfen, Ltd.
Hyde House, W. Central St.
London W.C.1, England

American Association for the
Advancement of Science
1515 Massachusetts Ave., NW,
Washington 5, D.C.

READER SERVICE CARD PAGES 869-870 ARE MISSING

10 years
mate
these
pointe
develo
aspect
of the
interru
have n
doning
model
all the
consul
he wo
exper
the n
the ca
ingless
gest,
there
in ear
thresh
level.
deny
thresh
but h
tion o
think
quant
proble
others
regar

But
cept c
writes
appea
dead,
not a
the d
a bio
to be
curve
time
1 and
incide
tumor
tion
amon
the p
see h
in a
within
can t
say,
the U
of th

Depa
Univ
and M
Bethe

1. H.
Ligh
1959
2. —
3. —
3. 8
4. H.
5. H.
ibid
6. H.
7. —
8. —
9. —

10 years ago (9) in which an approximate model for accelerated growth of these tumors was first developed. It was pointed out that the model as therein developed could account for certain aspects of the data but not for the data of these particular experiments with interrupted dosage. Since that time we have modified the model, without abandoning its essential form, to obtain a model which accounts satisfactorily for all these data. Apparently Berg has not consulted Figs. 45 and 47 in (1), since he would have found there that all the experimental points fit very well with the new model, and that this renders the calculation he has made quite meaningless. The curves as they stand suggest, although not unequivocally, that there is a slight amount of "recovery" in early stages, which would imply a threshold but certainly at a very low level. As I have said, however, I do not deny in the article the existence of a threshold for radiation carcinogenesis but hold that experimental demonstration of such a threshold is infeasible. I think that a careful consideration of the quantitative aspects of the data and the problem of carcinogenesis will lead others to the same conclusion in this regard that I have reached.

But perhaps Berg has a different concept of threshold than I have, since he writes, "if the first cancers are not to appear until after all the animals are dead, we have a practical threshold if not a biologic one." I must confess that the distinction between a practical and a biologic threshold puzzles me. It is to be noted that normal distribution curves such as those that describe the time of appearance of tumors (see Figs. 1 and 2) are not extrapolable to zero incidence, and the probability of a tumor appearing within such a population at any given time must depend, among other things, upon the size of the population. In such case I cannot see how the failure to observe cancer in a population of, say, 1000 mice within their life span of 1 or 2 years can tell us much about a threshold, in say, the 180 million human beings in the United States with a life expectancy of three score and ten years.

HAROLD F. BLUM

Department of Biology, Princeton University, Princeton, New Jersey and National Cancer Institute, Bethesda, Maryland

References

1. H. F. Blum, *Carcinogenesis by Ultraviolet Light* (Princeton Univ. Press, Princeton, N.J., 1959).
2. —, *J. Natl. Cancer Inst.* **23**, 319 (1959).
3. —, H. G. Grady, J. S. Kirby-Smith, *ibid.* **3**, 83 (1943).
4. H. F. Blum, *ibid.* **4**, 75 (1943).
5. H. G. Grady, H. F. Blum, J. S. Kirby-Smith, *ibid.* **3**, 371 (1943).
6. H. F. Blum, *ibid.* **4**, 559 (1943).
7. —, *ibid.* **23**, 343 (1959).
8. —, *ibid.* **23**, 337 (1959).
9. —, *ibid.* **11**, 463 (1950).

VIEWED FROM ANY ANGLE

EPSCO WORCESTER RECORDERS LEAD THE FIELD

In research in biophysics, physiology, and medicine — wherever versatility, performance, and economy are essential.

Take a look at these important Angles.

VERSATILITY

Interchangeable amplifiers will accommodate a wide range of transducers. Whatever the level or character of the signal, there is an EPSCO preamplifier to handle it.

PERFORMANCE

Sensitivity — from 1.0uv per mm.
Pressure measurements as low as 1mm. Hg per chart division.
Frequency Response — from D.C. to 200 cps produced through Plug-in compensators which provide extended frequency response or sharp cut-off.
Chart Speed — from .05mm to 500mm per sec.

ECONOMY

- Low initial cost.
Model 8205-6 (illustrated) 6 channel ink writing system complete \$4,365.00
- Low operating cost.
Compared to other writing systems, EPSCO's operating costs average up to 5 times less.

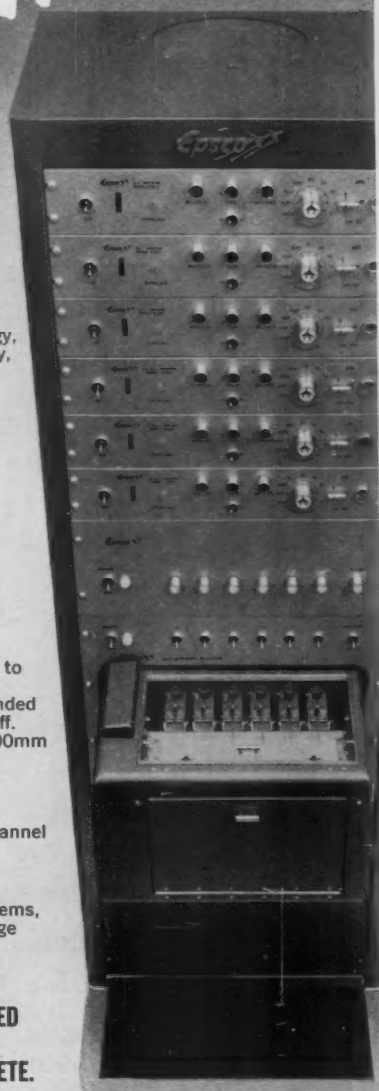
**NO ADDITIONAL EQUIPMENT
OR ACCESSORIES ARE NEEDED
TO MAKE THIS DYNAMIC
RECORDING SYSTEM COMPLETE.**

30 Day delivery on all EPSCO WORCESTER Recording Systems.

BIOPHYSICAL INSTRUMENTATION

Epsco  **WORCESTER**
A DIVISION OF **EPSCO INCORPORATED**

207 MAIN STREET WORCESTER 8, MASS. PLeasant 7-8394



Strontium-90 from Fallout

In two letters in *Science* (1, 2) reference was made to our work described in *Bone and Radiostrontium* (3).

Commoner (1) states that a contradiction exists between our finding "that microscopic regions of the bone may receive a radiation dose about 40 times the average" and the heterogeneity factor of 5 suggested in the U.N. report (4). This is not necessarily a contradiction, for our figure is applicable to acute intake conditions, while the U.N. report considers intake over a number of years. That the existence of chronic intake conditions decreases the hetero-

geneity of the strontium distribution has already been pointed out (see, for example, 5 and 6). In addition, it might be pointed out that the method of calculation used by Eisenbud (7) and criticized by Commoner (1) is correct in our opinion. It is, according to the U.N. report (4, p. 42, Table 2, note c), sufficient to consider the average dose if the corresponding maximum dose does not exceed the average by a factor of more than 80.

Kaplan (2) takes our recommendation of $0.1 \mu\text{C}$ of Sr^{90} as the body burden after acute intake and applies it directly to the fallout situation. This is not in correspondence with the view

expressed in (5): [The Sr^{90} contamination] "corresponds to a situation with aspects that lie somewhere between those of acute and chronic Sr^{90} poisoning. Children in the 0- to 5-year age group are examples of individuals with chronic poisoning conditions. Adults above 20 years of age are more likely to be examples of acute poisoning."

A figure of $0.0001 \mu\text{C}$ of Sr^{90} per gram as a level at which bone cancers were produced in dogs was cited in *Bone and Radiostrontium* (3) and cited again by Kaplan. This figure refers to radiothorium, however, and not to Sr^{90} . Although the figure cited is much too low in comparison with other experimental data, it seems to have caused confusion in the discussion of the biological effects of Sr^{90} , and this we sincerely regret.

R. BJÖRNERSTEDT, C. J. CLEMEDSON,
A. ENGSTRÖM, A. NELSON
Research Institute of National Defence,
Stockholm, Sweden

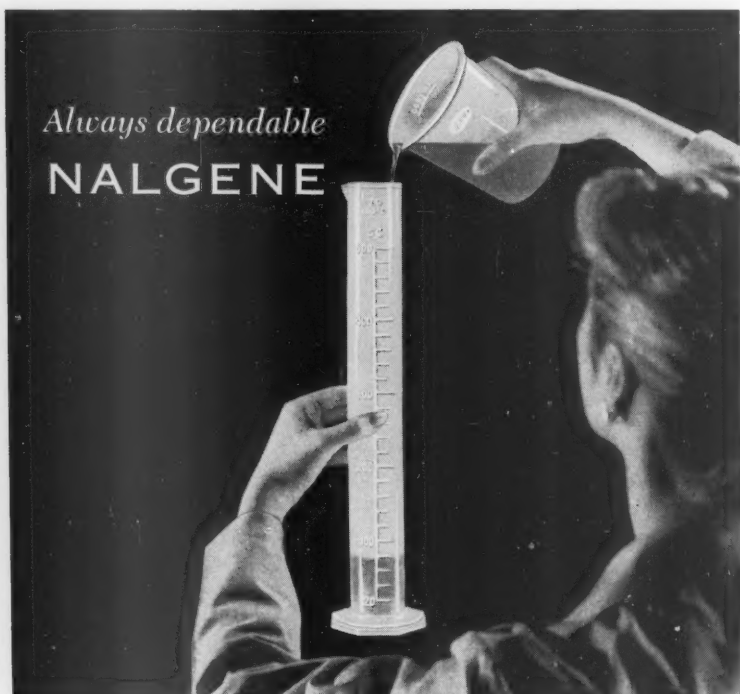
References

1. B. Commoner, *Science* **130**, 720 (1959).
2. J. G. Kaplan, *ibid.* **130**, 728 (1959).
3. A. Engström, R. Björnerstedt, C. J. Clemedson, A. Nelson, *Bone and Radiostrontium* (Wiley, New York, 1958).
4. Report of the United Nations Scientific Committee on the Effects of Atomic Radiation, Suppl. No. 17 (A/3838) (1958).
5. R. Björnerstedt and A. Engström, *Science* **129**, 327 (1959).
6. —, *Radioisotopes in the Biosphere* (Univ. of Minnesota Press, Minneapolis, in press).
7. M. Eisenbud, *Science* **130**, 76 (1959).

"Next Question" and K. E.

Tsiolkovsky

The editorial "Next question" [*Science* **130**, 1733 (25 Dec. 1959)] on attempts to pick up possible radio signals from the nearest stars (the project directed by Frank D. Drake) reminded me of analogous thoughts of Konstantin E. Tsiolkovsky, a Russian pioneer in rocketry. Tsiolkovsky's name is now well known to the American scientific public. His book *Exploration of Space by means of Reactive Apparatus* was published in Russia in 1896, and his name was given to one of the craters on the far side of the moon. In his little book *Monism of the Universe*, published many years ago in Kaluga, Russia, as well as in his letters to me (1933-35), he postulated the existence of highly developed intellectual societies in other worlds. Tsiolkovsky suggested, also, that such beings colonized many other planets by means of interstellar ships, painlessly destroying the products of unsuccessful biological evolution on other planetary bodies. The main objective of these intelligent beings is probably "humane colonization versus painful evolution," the evolutionary



Easily the safest, most practical lab ware

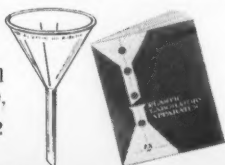
- **Unbreakable NALGENE** is light and easy-to-handle... never slippery even when wet. Prevents accidents.
- **Chemically-resistant NALGENE** delivers long-lasting, dependable service.
- **Economical NALGENE** saves money right at the start with its low initial cost.

For a FREE Nalgene funnel
and our Catalog H-459,

write Dept. 152



THE NALGE CO. INC. ROCHESTER 2, NEW YORK



+250°

IN THE LAB--

use **TIME TAPE** for best results!



Proven superior by actual use. Here is the toughest, most durable pressure-sensitive tape available. **WRITE ON IT! TYPE ON IT!** Acid, water, dirt, grease or heat don't affect it! Withstands temperatures from +250° to -70°! A variety of colors available in plain or pre-printed to your specs. Numbers, identification, warning and many other time-saving uses can cut costs and increase efficiency.

For samples and prices
write to — Dept. RSL

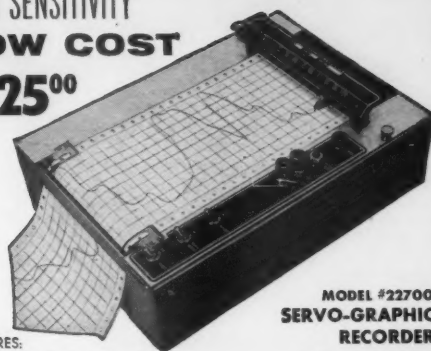
PROFESSIONAL TAPE CO., INC.
355 Burlington Ave. Riverside, Ill.



LABORATORY RECORDER

HIGH SENSITIVITY
LOW COST

\$325⁰⁰



**MODEL #22700
SERVO-GRAPHIC
RECORDER**

FEATURES:

- Pen travel 1 Second full scale.
- Accuracy 99% or better.
- Photoelectric Chopper for long life.
- Zener diode stabilized reference voltage.
- Adjustable paper speeds.
- Input suitable for high impedance sources.
- Adjustable range control.

RANGE: 0-10 MILLIVOLTS D.C.
0-100 MILLIVOLTS D.C.

The Servo-Graphic Recorder is an ideal laboratory instrument. Put it to work and save a valuable technician's time. O.E.M. users invited.

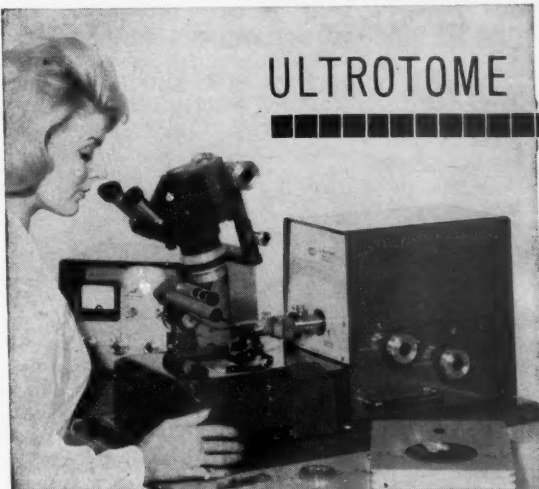
Write for literature

C. H. STOELTING CO.

12" CHART SERVO RECORDERS
MULTI-CHANNEL HIGH FREQUENCY OSCILLOGRAPHS
POLYGRAPHS • KYMOGRAPHS • MANIPULATORS

424 NORTH HOMAN AVE., CHICAGO 24, ILL.

ULTRATOME



sections for better electron microscopy

The NEW LKB 4800 Ultratome ALONE will feed your electron microscope with unbroken series of large-sized uniform sections

- Both push-button controlled and gentle automatic cutting.
- Five constant cutting speeds from 2 to 50 mm/sec (can be reselected any time during cutting).
- Controlled by separate transistor unit, so that even untrained operators can handle it.
- Three independent feed systems down to 50 Å per cut (linearized thermal, micro-mechanical, macro-mechanical).
- A single high-power stereo-microscope for inspecting knife edge, preparing specimen, and observing cutting.

In the U.S. and Canada:

LKB INSTRUMENTS, INC.

IN WASHINGTON'S SCIENCE INDUSTRY CENTER

5451 RANDOLPH ROAD, ROCKVILLE, MARYLAND

Write for bulletin
"Modern
Ultra-Microtomy"

Other countries:

LKB-PRODUKTER FAB

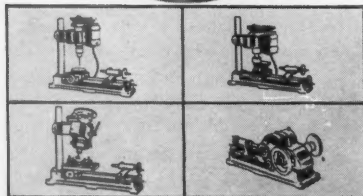
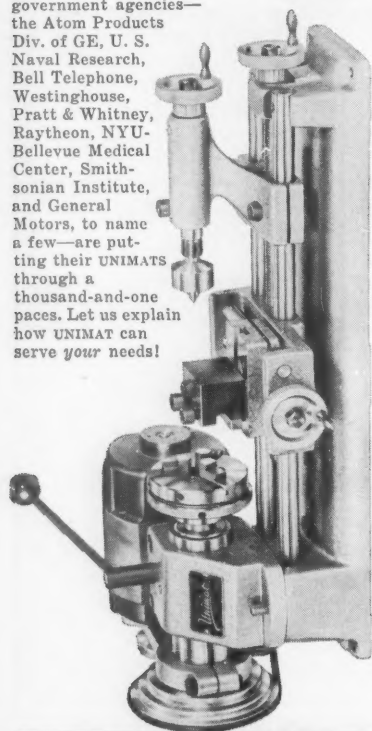
P.O.B. 12220, Stockholm 12, Sweden



LKB instruments are sold and serviced by authorized LKB distributors in more than 40 countries throughout the world.

EVEN WHEN STANDING ON ITS HEAD STOCK UNIMAT IS A PRODUCT DESIGNER'S BEST FRIEND!

MULTI-FUNCTION MACHINE SHOP-IN-MINIATURE (just 16" long) is indispensable to the modern research lab or model shop. Designers and engineers supplement their sketches with machined-to-scale models anybody can "read." Technicians turn out parts with micrometrically fine tolerances—down to .0005". Manufacturers developing new products save space and money in the mock-up shop by taking advantage of UNIMAT's amazing convertability. Hundreds of blue-chip companies, hospitals and government agencies—the Atom Products Div. of GE, U. S. Naval Research, Bell Telephone, Westinghouse, Pratt & Whitney, Raytheon, NYU-Bellevue Medical Center, Smithsonian Institute, and General Motors, to name a few—are putting their UNIMATS through a thousand-and-one paces. Let us explain how UNIMAT can serve your needs!



THIS IS THE BASIC UNIMAT, complete with lathe, motor, and all components for converting to drill press, vertical milling machine, tool and surface grinding machine, and polisher/grinder. Low cost attachments—jig saw, threader, circular saw, indexer/divider—are available, along with a complete range of machine accessories.

Write for illustrated literature and price list.

AMERICAN-EDELSTAAL/UNIMAT DIVISION
350 Broadway, New York 13, N.Y. Dept. AC

process being left alone on some planets for the purpose of "biological refreshing" only, Tsiolkovsky said. In another booklet, *The Unknown Intelligent Forces*, also in Russian, he wrote that those "others" probably have not yet tried to communicate with earth or with other bodies in our solar system because we are still not prepared for this. Such a communication would create confusion and panic in our society, and it is probable that the "others" have decided to wait for our signals.

I must add that these speculations of K. E. Tsiolkovsky have not been praised highly by the Soviet Government, for they are considered groundless and antimaterialistic. The authorities in Moscow could not touch Tsiolkovsky himself, because of his fame and popularity, but his secretary lost his job. The book *Monism of the Universe* ends with 14 corollary "R.M.S. theses" ("R.M.S." stands for *raznye mozno somnyevat'sya*, meaning, "can one doubt that . . ."), which repeat briefly the main conclusions and are very optimistic in tone.

ALEXIS N. TSvetikov

Department of Biophysics, Stanford University, Stanford, California

Scientific Nomenclature

I have long been disturbed by the unscientific character of scientific nomenclature. In all the sciences nomenclature has grown up by a succession of historic accidents. Ideally the name of anything should convey as much information about the object as possible. In most sciences the names of things convey hardly anything in themselves, and any connotation which they have has to be painfully learned. Even where the name of a scientific object has some relation to it, the connotation frequently reflects some accidental property or obsolete theory. It is true, in a way, that hydrogen generates water, as men generate babies, though this may not be its most important property. The connection of tellurium with the earth or of selenium with the moon is obscure.

Fortunately most scientists are unacquainted with the dead languages from which their nomenclature is largely drawn, and so scientific names generally convey merely zero, rather than negative, information. Fortunately, also, physics and chemistry have few enough objects of study so that the learning of a set of arbitrary names is not a hopelessly burdensome task. In biology the problem is very serious but probably hopeless. Biological nomenclature is such a hopeless and vast hodgepodge of historical, geographical, and personal accidents that one despairs of

ever reducing it to the slightest semblance of rationality, especially as the objects themselves seem to be the result of a hodgepodge of historical accidents also.

There is one field, however, where the objects of study have a nice rationality of position which makes possible a scientific nomenclature in which the name given to an object could be rich with information about it. This is astronomy. Like that of other sciences, astronomical nomenclature is a random historical mishmash of Greek, Arabic, and modern components. The name *Sirius* tells us even less about Sirius than the name *hydrogen* does about hydrogen. Star catalogs are a hopeless potpourri of letters and numbers obeying little or no rational principle. It is possible, however, to devise a system of star nomenclature whereby the name of any star would give in itself most of the essential information about it, so that, given the name, one could immediately deduce the position and properties of the star, or given its position and properties, immediately attach a name to it. It would probably be most rational to reform also the ancient method of counting degrees in sixties, and to go straight to a binary system of numbers. But this is perhaps too radical. Let us accept, therefore, the traditional definition of position in terms of degrees of right ascension and declination, or heavenly latitude and longitude. There are 360 degrees around the celestial equator. There are 19 usable consonants in the Roman alphabet, if we exclude *q* and *x*, which cannot be used to begin syllables. By a providential accident, 19×19 is 361. Two consonants, therefore, will define a degree of right ascension, in the scale of 19. Suppose we number the consonants as follows:

b	c	d	f	g	h	j	k	l	m
0	1	2	3	4	5	6	7	8	9

n	p	r	s	t	v	w	y	z
10	11	12	13	14	15	16	17	18

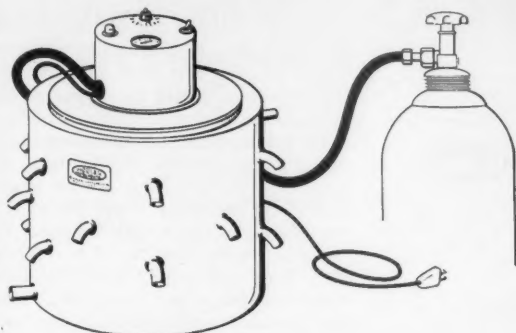
I grant that the roman alphabet and the languages spelled in it are also in sad need of reform, but here again one reform at a time is probably enough. We can now express any number up to 360 as an ordered pair of consonants. Thus, 0 would be *b,b*; $100 (5 \times 19 + 5)$ would be *h,h*; $200 (10 \times 19 + 10)$ would be *n,n*; $291 (15 \times 19 + 6)$ would be *v,i*. We only need 180° for the declinations, so we might use the first 180 pairs, or start with *b,b* at the South Pole, reaching *g,t* at the equator and *m,m* at the North Pole. We may note that translation from the scale of 19 consonants to the scale of 10 digits is very easy because every double consonant is a multiple of 20. Four consonants in order

FOR THE NEW APPROACH TO FREEZE-DRYING



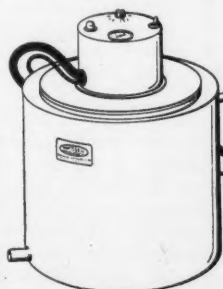
THE LYPHOLATOR

Buchler Lypholators are self-contained, compact units, designed to give greater efficiency as well as save considerable time.



- Buchler Lypholators eliminate the bothersome and time consuming preparation of cooling mixture—dry ice and acetone or ether. NOW . . . LIQUID CO₂ DOES THE JOB WITH 90% EFFICIENCY OF THE COOLING OPERATION.
- No solvent fumes to harm personnel or contaminate laboratory atmosphere.
- No explosion hazard.
- Temperature down to -75°C , $\pm 4^{\circ}\text{C}$.
- Buchler Lypholators are ideal in locations where dry ice is costly and difficult to obtain.
- Special internal, removable baffles prevent ice build-up.
- Temperature controller automatically activates CO₂ valve to maintain pre-set freezing temperature.
- Built-in liquid CO₂ indicator.

Buchler Lypholators are constructed of heavy gauge stainless steel. Ports are heli-arc welded stainless steel, fully annealed and electro-polished.

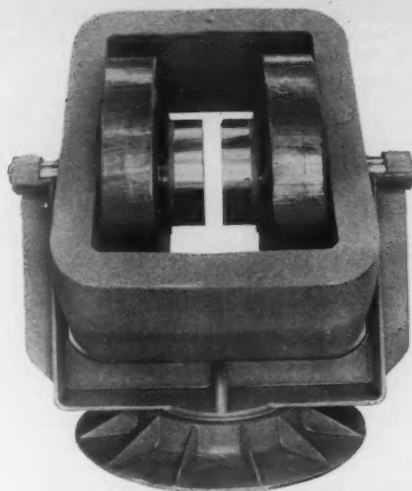


The Buchler Lypho-Trap incorporates the same unique freezing method and construction of the Lypholator and $\frac{3}{4}$ " ports provide greater efficiency. Used in conjunction with the Lypholator or glass Lypholization manifold.

For complete details, accessories and prices
write for bulletin 2-5000.



BUCHLER INSTRUMENTS INC.
formerly Laboratory Glass & Instrument Corp.
514 West 147th St., New York 31, N.Y.
Telephone: ADirondack 4-2626



MODEL L-128 PRECISION LABORATORY ELECTROMAGNET

The Harvey-Wells laboratory type electromagnet is specifically designed for applications requiring large volumes of high density, high homogeneity magnetic fields.

Construction features include a full H-frame yoke structure cast in only two pieces from high purity magnetic iron, low impedance tape wound coils, epoxy bonded, to form a monolithic structure of good mechanical strength and reliability. Field homogenizing sections are incorporated in each pole, and adjustable pole faces are provided for optimum alignment at any field strength setting. Any gap geometry up to 8-inch width may be provided by substitution of pole faces. The pole faces are accurately aligned by nuclear magnetic resonance techniques using a special, five-sample field probe developed by Harvey-Wells Electronics for this purpose.

The mount allows rotation about both the vertical and the horizontal axes. Provision is made for the alignment of the air gap center with the center of rotation. A Vernier scale is provided for accurate resetttings of positions about the vertical axis.



HARVEY-WELLS ELECTRONICS, INC.

14 HURON DRIVE
EAST NATICK INDUSTRIAL PARK
NATICK, MASSACHUSETTS

now give us the location of any star to within a square degree. We can now use the vowels to indicate other properties. The five vowels (*a, e, i, o, u*) with the 25 diphthongs (*aa, ea, ia, —down to ou, uu*) give us plenty of scope and can be numbered in order, giving us 30 possible vowels for each place. Thus, the first vowel could indicate the integer of magnitude; the second vowel, the first decimal of magnitude; the third vowel, color; the fourth vowel, spectral type, or whatever some distinguished international committee of astronomers decided was most important.

With a single name of four consonants we can name one star in each square degree. This gives us 64,800

names—adequate to name unequivocally all stars visible to the naked eye and even well beyond. There may be a few cases, in star clusters like the Pleiades, where a square degree has more than one star visible to the naked eye, but these must be rare. Then, by adding another similar name to the "sur-name" we can identify 360×360 or 129,600 stars per square degree, or over 9 billion in all. This names every square 10 seconds of the sky, which is probably enough for most astronomers. If necessary, a third name would cover all conceivable cases. The names are apt to sound a little Japanese or Italian, but this is surely a small sacrifice on the altar of a world science. Sirius per-

haps sounds a little uncouth as Zaca-fawe, Capella as Gadakugo, and Polaris as Bevamoli, but no doubt the ancient names could be retained for those who wanted to use them, and, as most stars have no names anyway, there would be no fine old traditions to stand in the way of their semantic baptism.

While I am on the subject of reform, having been a binarist from the word *bit*, let me suggest a simple method for saying the binary numbers. I say "saying" rather than "naming" because I do not really approve of naming numbers anyway, any more than I approve of gilding lilies. Even in the decimal system it seems to me foolish to *name* the perfectly good number one-nine-six-oh, or even, in a fit of centesimalism, nineteen-sixty, under the laborious title "one thousand nine hundred and sixty." Attempts to *name* the binary numbers end up in hopeless clumsiness and cacophony. On the other hand it is perfectly easy to *say* the binary numbers if we adopt one conventional symbol for "1" and another for "0." I have toyed with "Bim" for 1 and "Bam" for 0, in which case we would count: Bim, Bimbam, Bimbim, Bimbambam, Bimbambim, Bimbimbam, Bimbimbim, Bimbambambam, and so on. If this sounds too sonorous I am prepared to compromise on "Bit" (for 1) and "te" (for 0), in which case we count Bit, Bitte, Bitbit, Bittete, Bittebit, Bitbitte, Bitbitbit, Bittetete, and so on. I may point out that (to look a few years ahead) Bitbitbitbittebittebitbitbit has no more syllables in it than "one thousand nine hundred and sixty-seven." I have little doubt, however, that the fact that even scientists have ten fingers will tie the human race to a wholly arbitrary decimalism for many centuries to come.

K. E. BOULDING

University College of The West Indies,
Mona, Kingston, Jamaica, West Indies

STERILE COMPONENTS FOR PREPARATION OF TISSUE CULTURE MEDIA



Hyland offers a wide selection of sterile liquid and freeze-dried products for tissue culture and virus work—in a variety of sizes.

Serums and Serous Fluids
Serum Ultrafiltrates
Embryo Extracts and Ultrafiltrates

Balanced Salt Solutions
Synthetic Media
Special Formulations

Hyland freeze-dried tissue culture products offer these important, practical advantages:

- *Proven stability of labile components and growth factors.* The freeze-drying process preserves these factors indefinitely in their original state.
- *Sterility.* Each lot must pass rigid sterility tests. Products contain no preservative.
- *Long shelf life under normal refrigeration.* You may "stock-pile" enough material from one production lot to last through the life of your project, thus eliminating lot-to-lot variables.
- *pH problems eliminated.* Special diluent restores dried products to their original pH, without further adjustment.
- *Easy restoration.* Simply use syringe (or any aseptic technic) to reconstitute dried products to clear, particle-free solutions.

Hyland pioneered in freeze-dried plasma and blood fractionation products and has developed original drying methods which are especially suitable for tissue culture products. Consider the advantages of Hyland freeze-dried materials. Try them, and you will always specify them.

MAIL

THE COUPON
Hyland Laboratories
P.O. Box 39672
Los Angeles 39, Calif.

Our Tissue Culture Laboratory is at your service and welcomes your inquiries about special formulations and your suggestions about products you would like added to our line.

Please send me a listing of Hyland's complete line of sterile components for Tissue Culture Media.

Name _____

Organization
or Firm _____

Street _____

City _____ Zone _____ State _____

HYLAND LABORATORIES

4501 Colorado Blvd.,
Los Angeles 39, Calif.
160 Lockwood Ave.,
Yonkers, N. Y.

Tax Exemption and Research

In the 1 January issue of *Science* [131, 7 (1960)] appears the editorial entitled "Tax exempt." I am sure you would be among the first to concede that the tax treatment of scientific research is a subject far too complex to be covered adequately in the single page of an editorial. Nevertheless, the subject is also too important to be dismissed lightly; and to a society having as its purpose the *advancement* of science, proposals to tax research have far-reaching implications that deserve more extensive attention than is given by your short article.

Some statements in your editorial are contrary to fact. The newly proposed

The Study of Elementary Particles by the Photographic Method

An account of the Principal Techniques and Discoveries

Illustrated by an Atlas of Photomicrographs

C. F. Powell, P. H. Fowler and
D. H. Perkins

Lavishly illustrated 8¼" x 10½" \$40

A Laboratory Manual of Analytical Methods of Protein Chemistry (including Polypeptides)

3 volumes

Edited by P. Alexander and R. J. Block

Vol. 1. The Separation and Isolation of Proteins

Illustrated \$8.50

Available on request:

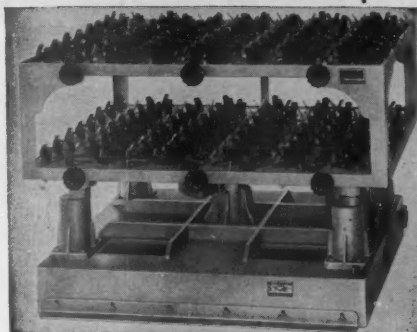
1960 Catalog of Scientific and
Mechanical publications. 120 pages.

PERGAMON PRESS, INC.

122 EAST 55TH STREET, NEW YORK 22, N.Y.

GYROTORY® SHAKER

MODEL
G52



Large Capacity, Powerful Rotary Shaker
Precision Built for Continuous Duty

- Variable speeds of 150-350 rpm, with 2" stroke.
- Heavy duty, 5 eccentric shaft stabilizing system.
- Positive, uniform shaking to ALL flasks.
- Continuous, quiet, cool and dependable operation.
- Holds a variety of flasks on 6 removable trays.
- Model TR available with reciprocating motion.



Write for Catalog G52-3185

NEW BRUNSWICK SCIENTIFIC CO., INC.

PRECISION LABORATORY APPARATUS

P.O. BOX 606, NEW BRUNSWICK, NEW JERSEY

LOW IN COST... PORTABLE, TOO!

NEUTRON OUTPUTS UP TO 10^{10} NEUTRONS/SEC

FOR USE IN:

- All types neutron diffusion assemblies on fast, intermediate and slow, critical studies.
- Activation Analysis
- Neutron Scattering and Nuclear Reaction Research
- Radiation Damage Studies
- Biological Studies
- Training of Nuclear Scientists
- Instrument Calibration
- Well Logging Research

• Models completely installed with targets begin at \$19,950. FOB Austin. (Larger units also available)

A unit so compact it can be moved easily from one laboratory to another if desired.

FACTS AND FIGURES

Output up to 10^{10} neutrons/sec continuous: remote operation; mobile; no special building facilities needed. Easily operated and maintained; Beam Pulsing system available.

For further information, write:
DEPARTMENT DD

TEXAS NUCLEAR CORPORATION

P. O. Box 9267

Austin 17, Texas



Tired of



by **I²R** INSTRUMENTS for RESEARCH and INDUSTRY CHELTENHAM, PA.

and remember...

for Versatile temperature control

THERM-O-WATCH

I²R INSTRUMENTS for RESEARCH and INDUSTRY CHELTENHAM, PA.

Catalog Available

regulations do *not* say that an organization to be exempt must "be operated primarily for fundamental research," as stated in your editorial. The Internal Revenue Service has apparently had the wisdom to see that the dividing line between "basic," "fundamental," and "applied" research is something that scientists themselves do not agree on, and to see that it does not provide a proper basis for taxation.

The newly proposed regulations do set forth as a test of whether research is "scientific" that the results of such research must be made freely available to the public. This strikes me as a curious definition of the term *scientific*, since it makes the method of dissemination rather than the scientific nature or content of the research the test of whether the research is scientific. Of course, the significance of this definition of *scientific*, as stated in the new proposed regulations, turns on what is meant by the "freely available" test. The proposed regulations seem to intend to limit this test by a concept which sets as the standard that the research is directed not toward promoting private gain but rather toward benefiting the public.

There is a shocking fallacy implicit in a concept which places private gain in opposition to public benefit. The economic and political system of this country is founded on the principle that there are public benefits from the opportunities for private gain. Certainly the public is benefited where the opportunity for private gain leads to the promotion or support of scientific research. As I understand it, all that the tax laws require as a qualification for exemption from tax is that the net earnings of an exempt organization should not inure as a private gain to the members of the exempt organization; but the fact that research leads to someone else's private gain (that is, gain for industry and, in fact, for the public itself) does not mean that research is directed any the less toward benefiting the public.

The concept expressed in the regulations goes to the root of other tax exemptions. The editorial itself points to the danger and inconsistency in the proposed regulations in this regard. In indicating which organizations will be affected or not affected by the regulations, the editorial points out, for example, that universities will not be affected, and in this connection you state that their exemption includes "income derived from applied research that is not available to the public." At the same time the editorial indicates that independent research institutions carrying on the same activities will be affected. If such activities are not in the public interest when conducted in such institutions, will not this conclusion

strike at the basis for exemption for all other organizations conducting research? If science itself is found unworthy of the protection of tax-exempt status because private gain may be derived from the application of scientific research, then neither education nor any other purpose will long provide an effective tax screen, for the conduct of research in any institution would then inevitably be considered to be in the domain of taxable business enterprise. I am sure that the American Association for the Advancement of Science cannot remain indifferent to this prospect.

The proposed regulations raise another fundamental question that the association may very well want to ponder. As pointed out in the editorial, under the proposed regulations any research done for a government agency would be considered of an exempt character, but research conducted for industrial sponsors would generally not be. This would make the course of future research organizations dependent upon government programs and would require that they primarily serve government agencies as a price for tax exemption. The freedom heretofore enjoyed of pursuing scientific research in the interest of increasing scientific knowledge, regardless of who sponsors the research, would be lost, and in its place would be the necessity of committing the institution to the mercy of government programs in order to maintain tax-exempt status. This loss of scientific freedom poses a question of great importance for those interested in the advancement of science in a free society.

B. D. THOMAS

Battelle Memorial Institute,
Columbus, Ohio

The proposed regulation is, indeed, complex; but with reference to the question of fundamental research it has this to say: "... for purposes of the exclusion from unrelated business taxable income provided by section 512(b)(9), it is necessary to determine whether the organization is operated primarily for purposes of carrying on 'fundamental,' as contrasted with 'applied' research."

—Ed.

Population Control by Release of Irradiated Males

The article by E. F. Knipling in *Science* [130, 902 (1959)] on possible methods of insect control by treatment of males with radiation or chemicals is interesting and illuminating. It should be pointed out, however, that where males are irradiated and released in the field, the restriction of monogamy in females of a species is not a requirement for



CHICAGO, U.S.A.

MEDICAL MICROSCOPES

Most reasonably priced **GUARANTEED** Microscope on the market.

Made in West Germany

NEW DESIGN
EXCLUSIVE
SAFETY FEATURES
HIGH QUALITY OPTICS
GRADUATED
MECHANICAL STAGE
TEN YEAR GUARANTEE

\$257.00

WITH CASE

Write for catalogue
listing safety features

10% Discount on 5 or more.
Models may be assorted to obtain this discount

TRANSPORTATION
INCLUDED

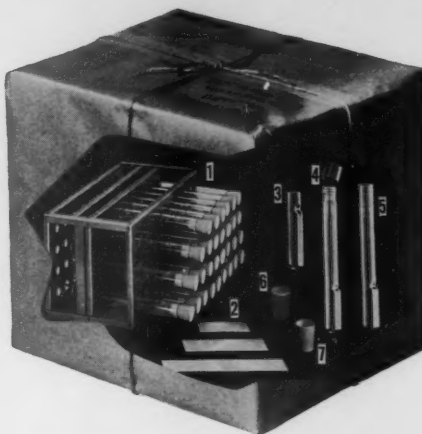


THE GRAF-APSCO CO.

5868 BROADWAY

CHICAGO 40, ILL.

A PACKAGE UNIT FOR TISSUE CULTURE TUBE STUDIES!



1. Self-locking rack
2. PRECUT cover slides
3. Short type tube
4. Screw cap tube
5. Rubber stoppered tube
6. Rubber stopper
7. Silicone rubber stopper

WRITE FOR COMPLETE DETAILS



BELCO GLASS INC.
DEPT. 55 — VINELAND, NEW JERSEY

SAVE With The ALL NEW Aloe-Petrolite VENTILATED FUME HOOD

Removes fumes without loss of conditioned air

Simple in design / Economical to install / Easy to maintain. In addition to protecting laboratory personnel from obnoxious or toxic gases, the Aloe-Petrolite Fume Hood saves conditioned air. Not only in the room where it is installed, but in the entire building. Losing cooled or heated air through fume hoods places an extra load on refrigeration and heating equipment. Result: unnecessary expense. But—by using *outside* air instead of room air, to carry off fumes, waste of conditioned air is stopped. This hood does just that. It operates as an independent unit, completely isolated from rest of room. And in air conditioning savings it can pay for itself.

ANOTHER MEMBER OF THE
MODULINE
FAMILY OF FINE CASEWORK

Descriptive bulletin and all details are yours for the asking. Write or call us today.

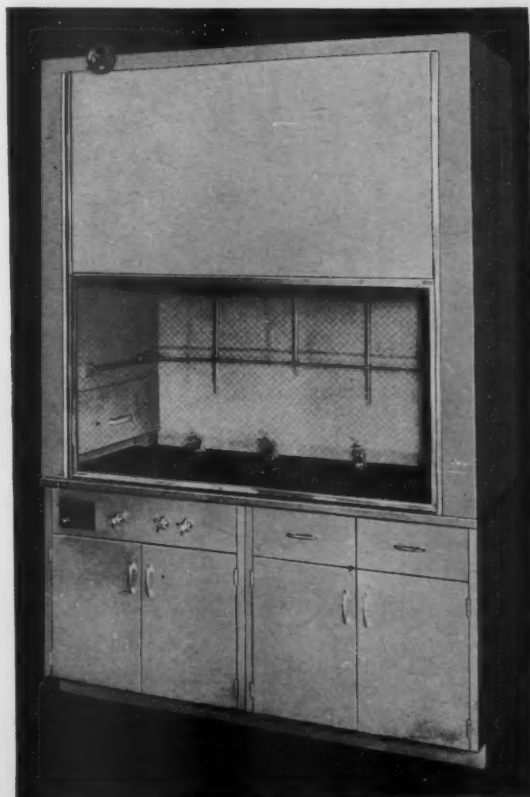


aloe scientific

DIVISION OF A. S. ALOE COMPANY
General Offices

5655 Kingsbury • St. Louis 12, Missouri

FULLY STOCKED DIVISIONS COAST-TO-COAST





Roland Gohlke, Dow Chemical Company engineer, using Bendix Mass Spectrometer to identify compounds emerging from a gas chromatograph.

NOW BENDIX* TIME-OF-FLIGHT MASS SPECTROMETER RECORDS MASS SPECTRA

The ability to record either mass spectra or mass ratios further widens the versatility of the Bendix Mass Spectrometer. The speed and ease of using this new Analog Output System are illustrated by the following example:

During a recent routine analysis performed at our Research Laboratories Division, one hundred mass spectra were recorded on a direct writing recorder in less than two hours. These were the mass spectra

of the eluted components of a mixture being separated by a gas chromatograph and fed continuously into the Bendix Spectrometer for identification.

For complete details contact the Cincinnati Division, Dept. E6-5, 3130 Wasson Road, Cincinnati 8, Ohio. Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N. Y. Canada: Computing Devices of Canada, Ltd., Box 508, Ottawa 4, Ontario.

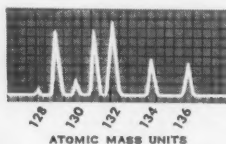
*TRADEMARK

APPLICATIONS

- Chromatograph output identification.
- Molecular beam analysis, including solids' analysis and high temperature research.
- Fast reaction studies such as rocket exhaust analysis.
- Analysis of ions created outside the mass spectrometer.
- Negative ion studies.
- Simple, rapid analysis.

FEATURES

- **RUGGED**—The Dow Chemical Company experienced only 1/2 of one percent downtime for maintenance during the first six months of operation.
- **FAST**—10,000 mass spectra per second.
- **HIGH RESOLUTION**—Usable adjacent mass resolution beyond 500 a.m.u.
- **VARIOUS OUTPUTS**—Oscilloscope used alone or in combination with ion pulse counting or recording outputs.



Oscillogram of xenon spectrum.

- **WIDE MASS RANGE**—Each spectrum covers 1 through 4000 a.m.u.
- **SIMPLE, OPEN CONSTRUCTION**—Permits easy modification for special problems.
- **ALUMINUM GASKETS, HIGH TEMPERATURE FEEDTHROUGHS**—Permit effective bakeout.

controlling population size, since sterility of the males (*sensu stricto*) is not necessarily the radiation effect which causes the population decline. Even with multiple matings by every female, the population collapse would be as inevitable and rapid as when the females are monogamous.

The effect of radiation which probably is most important is the induction of dominant lethality in the sperm, not male sterility. For illustration, let us consider an insect population made up of ten males and ten virgin females. Ninety irradiated males are introduced into this population. The females mate only once. When perfect randomness is assumed in this simple example, the probability exists that nine of the females will mate with irradiated males and produce no viable offspring, and that one will mate with a normal male and produce normal offspring. One hundred percent of the eggs from one female will survive. In this case, it will not matter whether dominant lethals are induced in the sperm or the males are made sterile.

Now consider the same conditions, but let every female mate ten times. Each female will mate with ten males, nine of which contain dominant lethals and one of which has normal sperm. Ten percent of the eggs from each female and 10 percent of the total batch will survive; this is in accord with the rule of strict monogamy, even though polygamy is the case here. If the irradiated males are sterile, 100 percent of the total batch of eggs survive.

It is obvious that, if the primary action of radiation is that of inducing dominant lethality in the sperm, the results are identical whether female monogamy or promiscuity obtains. In practice, one of course can imagine circumstances whereby monogamy or polygamy could influence the rate of decline, and according to the circumstances, polygamy actually could be an advantage for population collapse.

It is generally known that at levels of radiation of about 10 kiloroentgens to either the fly *Drosophila* or the wasp *Habrobracon*, dominant lethal events are induced in over 99 percent of the sperm. However, to obtain complete killing of the sperm, radiation levels of about 200 kr are required [for observations on *Habrobracon*, see Whiting and von Borstel, *Genetics* 39, 317 (1954)]. It has been observed in *Drosophila* that dominant lethals are induced in mature sperm and spermatocytes in later stages of spermatogenesis, and that after these are exhausted a period of sterility sets in, from which, at doses of about 10 kr, the flies never recover [see Welshons and Russell, *Proc. Natl. Acad. Sci. U.S.*

Cincinnati Division
CINCINNATI, OHIO



43, 608 (1957)]. The process of sperm exhaustion following irradiation requires about a week of continuous multiple matings, but *Drosophila* males that have not been mated for 19 days after irradiation still have sperm reserves containing dominant lethals [Demerec and Kaufmann, *Am. Naturalist* 75, 366 (1941)]. With the simple cytological procedures now available for determining, at different doses of radiation, the components of dominant lethality [von Borstel and Rekemeyer, *Genetics*, in press] and sterility [Welshons and Russell, *Proc. Natl. Acad. Sci. U.S.* 43, 608 (1957)], there should be little difficulty in determining dose-effect relations for any insect.

Knipling pointed out in an earlier paper [*J. Econ. Entomol.* 48, 459 (1955)] that competition of sperm from irradiated males with that of normal males can replace strict monogamy as a prerequisite for success of the irradiated-male technique for eradicating insect populations. He also quoted the observation of Bushland and Hopkins [*J. Econ. Entomol.* 46, 648 (1953)] that fertilization of eggs by irradiated *Callitroga* males occurred in the screwworm experiment. Death of the *Callitroga* embryos must have been through induced dominant lethality in the studies of Bushland and Hopkins. Admittedly, if monogamy is the rule, dominant lethality and sterility are equally effective, but the two effects of radiation must be neither lumped nor confused. By a curious historical quirk, the dominant-lethality concept was completely shadowed by the well-executed and dramatic experiments of Baumhover and his associates [*J. Econ. Entomol.* 48, 462 (1955)] in eradicating the screwworm from Curaçao, since *Callitroga* apparently mates once. Since the males were irradiated as early pupae, it is possible that both dominant lethality and true sterility were contributing factors to the success in Curaçao and the recent success in Florida of efforts to eradicate the screwworm.

The reason for again drawing attention to the feature of dominant lethality induced by radiation is that the restriction of monogamy has been fixed in the minds of many entomologists with whom I have discussed this problem. Also, the author of a theoretical discussion on the eradication of the tsetse fly [Simpson, *Biometrics* 14, 159 (1958)] is concerned about the monogamous restriction, since Nash [*Bull. Entomol. Research* 46, 357 (1955)] has evidence that multiple matings take place in the tsetse fly.

With the potential of the induced-dominant-lethality method for insect eradication barely explored, and since with radiation the dosage can be con-

FROM A SIMPLE ADDITION to a COMPLETE LABORATORY—

THE
DURALAB

TEAM works
for you!*



Send for our new complete Catalog D5

Sweets File No. 23L

A.I.A. File No. 35-E

Working directly with architects, engineers and lab personnel, your particular requirements are integrated into plans for a finished job to serve you efficiently, economically and provide for the utmost in utility.

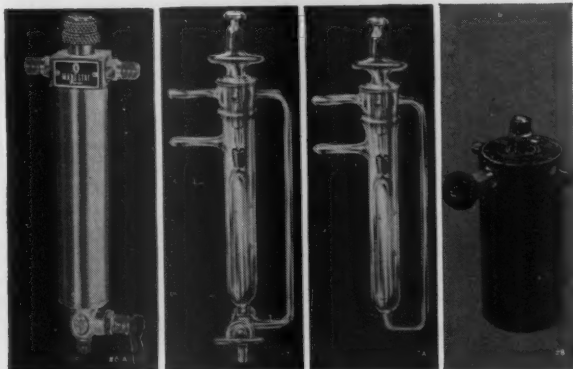
FACTORY TRAINED FIELD REPRESENTATIVES
IN PRINCIPAL CITIES

DURALAB EQUIPMENT CORP.

Manufacturers and Designers of Laboratory Furniture & Equipment
980 LINWOOD STREET, BROOKLYN, N. Y.

CARTESIAN

for
automatic
vacuum
and
pressure
control



MANOSTATS

They remember your vacuum setting even after shutting down system! No other instruments in the field can compare with these remarkable Cartesian Manostats for sensitivity, accuracy and reliability. Designed on the simple phenomenon of the Cartesian Diver, their construction, installation and operation is uncomplicated and dependable.

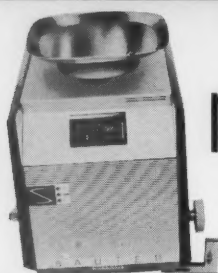
For complete information, write for Constant Pressure and Vacuum Control Bulletin.

The EMIL GREINER Co.
20-26 N. MOORE STREET (666) DEPT. 427 N. Y. 13, N. Y.

The Emil Greiner Co., Dept. 427
20-26 N. Moore Street, New York 13, N. Y.
Please send me Cartesian Manostat Bulletin.

NAME _____
COMPANY _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

SAUTER



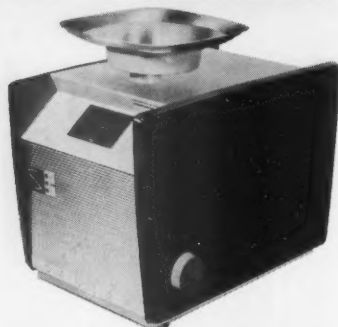
new

S-1000 SERIES

REVOLUTIONARY

FROM EVERY ANGLE

TOPPAN



The only balance of its kind with full floating indicating mechanism for correct weighing regardless of off-level conditions. TOPPAN can be placed on any table and operated immediately without zeroing-in or leveling. Bright highly legible projection scale. No weights required. For weighing beyond optical range, just turn control lever to remove a substitution weight. The added capacity is indicated in window adjacent to projection scale.

- Front and rear reading scales for control by more than one person.
- Pilot light indicates taring device is in use.
- Magnetic damping for quick oscillation and stability of projection scale.
- Lever locks mechanism for relocating balance.
- Extra large, unobstructed interchangeable pans.
- Capacities: S 1000 - 1000g
S 2000 - 2000g
S 4000 - 4000g

Measurements 9 7/8" W x 14 1/4" H x 12 1/4" D

Illustrated Literature on Request



trolled so accurately, the radiation method should be exploited more fully, even while Knippling's suggestion (1959) for seeking chemical compounds for inducing sterility in the field (species-specific? accurate dosage?) is being undertaken. There are of course many problems faced by entomologists when they inquire into the economic suitability of methods for control of any particular insect species. But with monogamy not necessarily a restriction with the irradiation-of-males method, it seems possible that this could often become the procedure of choice when the most economically desirable method for eradication is being determined, as with experiments now in progress to rid Guam and Hawaii of fruit-fly infestations. It seems possible that the tsetse fly could even be eradicated from Africa by this method; besides radiation biological supplementation of the excellent investigations now being carried out, what would be required is sufficient money for developing large-scale methods of artificial rearing, irradiation, and release.

R. C. VON BORSTEL*

*Istituto di Genetica,
Università di Pavia, Pavia, Italy*

Note

*National Science Foundation senior postdoctoral fellow, on leave of absence from the Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.

The points brought out by von Borstel are good, and I am pleased that he is commenting specifically on the relative effect of monogamy and polygamy in the application of the sterility method of population control when the effect produces dominant lethals in the sperms. I have for some years attempted to correct the misconception that monogamy is a prerequisite to successful application of the approach to population control. In our investigations with several species of insects, including tropical fruit flies and *Anopheles* mosquitoes, there are indications that among such species having polygamous mating habits, the male-sterility method may provide an effective means of control. However, the depressing effect on the population among these species is less than in the screwworm, which is monogamous in mating habits. The probable reason is that irradiation may reduce the number of the sperms or their ability to compete with normal sperms.

In the absence of adequate information on the effects of irradiation on sperms, I stressed the theoretical possibilities of population control among species monogamous in mating habits.

E. F. KNIPLING

*Entomology Research Division,
Agricultural Research Service,
Beltsville, Maryland*

PhD's

PHYSICAL CHEMISTRY

Position available in new and challenging field for physical chemist interested in solution chemistry. Experience desirable, but not necessary.

BIOCHEMISTRY

Basic food research department needs both experienced and inexperienced physical-biochemists for fundamental studies in starch and protein chemistry.

ORGANIC CHEMISTRY

Immediate need for organic chemists to perform chemical research leading to the development of new products. No experience necessary.

Challenging assignments in the above fields afford an unusual opportunity for accomplishment and advancement. Relocation allowance, extensive benefit program.

send complete resume to:

Department 8



Central Research Laboratories

2010 East Hennepin Ave.

Minneapolis 13, Minn.



Crystals are not just a sideline at ISOMET. Years of research and development have enabled us to produce consistently the highest quality crystals obtainable and at attractive prices. We go all out to serve you with

**HIGHEST QUALITY
ATTRACTIVE PRICES • PROMPT DELIVERY**
—three good reasons why leading spectroscopists everywhere are turning to ISOMET for their crystal needs. Why don't you try us on your next order.

NaCl, KBr, KCl, KI, CsBr, CsI, BaF₂, MgO
Rough blanks, polished windows, prisms, special shapes.
Standard liquid and gas cells; special cells.
Repair and polishing service for cells and windows.
KBr Pellet Powder.



WRITE TODAY for price list and free Technical Bulletin No. 1577.

Isomet
CORPORATION

P.O. Box 34—Palisades Park, N. J.

KIMBERLY-CLARK CORPORATION NEEDS RESEARCH SCIENTIST

LOCATION—Research and Development Center, Neenah, Wisconsin

EDUCATION—Prefer man or woman with PhD in Chemistry, Physics or ChE. Should have interest in Biology, Bio-chemistry, Physiology or related subjects.

Will consider BS or MS if experienced in product design.

NATURE OF WORK—Applied research with special emphasis on the development of new products.

SALARY—Commensurate with training and experience.

WRITE—For additional information to:

Russell J. Piltz,
Manager, Personnel Procurement
**PERSONNEL DIVISION
KIMBERLY-CLARK CORPORATION
NEENAH, WISCONSIN**

all replies confidential

PERSONNEL PLACEMENT

CLASSIFIED: Positions Wanted, 25¢ per word, minimum charge \$4. Use of Box Number counts as 10 additional words. Payment in advance is required. **Positions Open**, \$33 per inch or fraction thereof. No charge for box number.

COPY for classified ads must reach **SCIENCE** 2 weeks before date of issue (Friday of every week).

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	\$40.00 per inch
4 times in 1 year	38.00 per inch
7 times in 1 year	36.00 per inch
13 times in 1 year	34.00 per inch
26 times in 1 year	34.00 per inch
52 times in 1 year	32.00 per inch

For **PROOFS** on display ads, copy must reach **SCIENCE** 4 weeks before date of issue (Friday of every week).

Replies to blind ads should be addressed as follows:

Box (give number)
Science
1515 Massachusetts Ave., NW
Washington 5, D.C.

POSITIONS WANTED

American and European Degrees: 12 years' medical practice; 11 years of medical research for government agency. One-time commissioned U.S. public health officer. Top expert in European medicine and public health. Knowledge of all leading European languages. Wide travel experience. Writing ability. Public speaker. Woman, pleasing personality. Desires change from present government position to research organization, industry, or publisher. Preferably greater Washington area. Box 61, **SCIENCE**.

Virologist-Tissue Culturist. Prospective Ph.D. (June 1960). Trained in immunology as well; seeks position. Box 63, **SCIENCE**.

POSITIONS WANTED

(a) **Animal Science** Ph.D., nutrition-physiology minors; 3 years' animal husbandry teaching and 14 years' agricultural research experience; available for teaching or research appointment. (b) **Zoology** M.A. with physiology minor; research in embryology and tissue culture; desires research position. (c) **Biochemist** Ph.D., teaching and research experience, 12 years as head of hospital sections; prefers clinical appointment of responsibility. S3-3 Medical Bureau, Inc., Science Division, Burnice Larson, President, 900 North Michigan Avenue, Chicago.

POSITIONS OPEN

Bacteriologist. \$7938-\$9138 annually. Position open in clinical bacteriology at large suburban Detroit hospital near University of Michigan and Wayne State University. Well-equipped laboratory available for research. Liberal annual and sick leave, retirement plan plus social security. Ph.D. required. Contact Dr. S. E. Gould, Director of Pathology, Wayne County General Hospital, Eloise, Michigan. 3/11; 3/18

Biophysicist-Electrophysiologist. For research on electrophysiology of vision in large midwestern university. Ph.D. or equivalent. Experience with electrophysiological equipment required. Eye experience not necessary. Salary from \$7500, depending on training and experience. Box 56, **SCIENCE**. 3/18, 25

Botany-Pharmacognosy. Recent Ph.D. wanted for teaching, starting next September. Write, including résumé, to Director, Department of Biology, Philadelphia College of Pharmacy and Science, Philadelphia 4, Pa.

Chemists, organic, with physical or biochemical interest. Research on structure of proteins, other biological polymers, in cancer research institute, University affiliated. Research may be used for advanced degree thesis. Write to Director, Biophysics Department, Roswell Park Memorial Institute, Buffalo, N.Y.

POSITIONS OPEN

BIOLOGICAL SCIENTIST

Well-known pharmaceutical firm located in Philadelphia has opening available for alert individual having M.S. or B.S. in the pre-clinical sciences. Some foreign language ability also desirable. Must be interested in abstracting and indexing of current scientific literature. Outstanding benefits including tuition assistance. Please submit complete resume.

Box 53, **SCIENCE**

Medical Technician, male or female, B.S. preferred, research laboratory. Paraffin sectioning, H and E plus special staining. Some experience required. Dr. J. Christensen, St. Barnabas Medical Center, High St., Newark, N.J. 3/11, 18

Microbiologist. M.S. or Ph.D. for chief post in a three-man laboratory that services the hospital and Isaac Albert Research Institute. research potential, new facilities, living accommodations, 30 minutes from New York City, good salary plus grant supplementations. Personnel Department, Jewish Chronic Disease Hospital, East 49 Street, Brooklyn 3, N.Y. 3/18, 25

ORGANIC CHEMIST

M.S. or B.S. with experience preferably in the pharmaceutical or agricultural chemical field; for synthesis of new biocidal compounds and interpretation of test results. An excellent opportunity for independent work. Please forward complete résumé to: A. E. Balint.

Metal & Thermit Research Laboratory
Railway New Jersey

BIOCHEMIST

THE COLONIAL SUGAR
REFINING COMPANY LTD.

has a vacancy for a Biochemist

Qualifications:

Good Honours degree in biochemistry or equivalent. Preferably with 4 to 5 years' research experience. Experience in enzymology, in the use of isotopes, and an interest in plant biochemistry and physiology would be an advantage.

Duties:

To carry out investigational work on sugar synthesis, transformations and storage in sugar cane.

Conditions:

First-class fares to Australia for appointee and his family from place of engagement. Generous superannuation benefits and financial assistance towards home ownership will be available.

Location:

Initially in Sydney, N.S.W., and moving to Brisbane, Queensland, in late 1960.

Age:

About 30 years.

Salary:

Initial salary within the range of £1600 to £2500 (Australian) per annum.

Closing Date for applications,
18th April, 1960.

For further information write to
The Director of Research,

The Colonial Sugar Refining
Company Ltd.
Box 483, G.P.O.,
SYDNEY, AUSTRALIA

POSITIONS OPEN

Chemist-Biochemist. M.S. level or above. Medical research program. Particular emphasis on cellular physiology, enzymes, and electrolytes. Position in Career Civil Service. Reply to Manager, Veterans Administration Hospital, East Orange, N.J.

Instructorships (3) at West Coast urban university—teaching in general biology, general zoology, general botany, advanced invertebrate zoology, and plant physiology. Research field open, but broad biological background essential and marine interest somewhat preferred. Box 60, SCIENCE, 3/18

(a) **Research Biochemist** trained in chromatographic-electrophoretic techniques and peptide studies; for research center, Southwest. (b) **Faculty Appointment at Liberal Arts College**; Ph.D. or M.S. degree, to teach biology-zoology courses; Midwest. (c) **Senior Toxicologist** for department of health; South. (d) **Head of Veterinary Research**, international division of drug firm; will establish and supervise foreign research projects; speaks Spanish. (e) **Physiologists**, Ph.D. or M.D., for faculty appointments of medical school; all levels, \$5000-\$10,000 year; East. (f) **Endocrinologist** section head for reproductive physiology research and supervising; large drug firm. East. (g) **Clinical Biochemist** to take charge of department in hospital; Northwest. (h) **Chemist** with knowledge of electronics or physics for research at important medical center; Pacific coast. (Please write for details; also many other positions available through our nationwide service.) S3-3 Medical Bureau, Inc., Science Division, Burneice Larson, President, 900 North Michigan Avenue, Chicago.

Science Teachers, Librarians, Administrators urgently needed for positions in many states and foreign lands. Monthly non-fee placement journal since 1952 gives complete job data, salaries. Members' qualifications and vacancies listed free. 1 issue, \$1. Yearly (11 issues) membership, \$5 individual; \$10 institutional. CRUSADE, SCI., Box 99, Station G, Brooklyn 22, N.Y. ew

Writer for weekly journal to report developments in national and international affairs that bear on science. Familiarity with the Washington scene helpful, background in natural science helpful, experience as a journalist necessary. Position and salary open. State qualifications in a letter to Editor, SCIENCE, 1515 Massachusetts Avenue, NW, Washington 5, D.C. ew

POSITIONS OPEN

Marine Biologists and Oceanographers. Vacancies in the Public Service of Canada offer interesting careers in fisheries research for bachelor graduates with 2nd class honors or better. Group A: Three Biologists are wanted to conduct age and growth, life history, and other studies of groundfish; one Biologist is wanted to conduct research on plankton of waters of the Newfoundland area; one graduate in physics and mathematics is wanted to conduct hydrographic studies in support of researches on groundfish. All of the foregoing will be located at this Board's marine laboratories at St. John's, Newfoundland. (University facilities are available for graduate studies in the employee's spare time.) Group B: Our marine laboratory at Nanaimo, British Columbia, has a vacancy for a graduate having a Ph.D. degree or equivalent in physics and mathematics, preferably with training in fluid dynamics, to study the dynamics of ocean circulation and develop theoretical knowledge of steady and time-dependent processes in the ocean.

Appointments to supervisory positions and/or candidates with doctoral degrees may be made at the **Associate Scientist** level which begins at \$6000; other candidates may be appointed at the **Assistant Scientist** level which begins at \$4600 per annum. Applications should be accompanied by statements of personal history, transcript of academic record, a recent photograph, and recommendations from former employers and professors, and will be received until 31 March 1960, at the following addresses: Group A—Biological Station, St. John's, Newfoundland; Group B—Pacific Oceanographic Group, Nanaimo, British Columbia. X

SCIENTIST LITERATURE ABTRACTOR

Well-known pharmaceutical firm located in Philadelphia has opening available for alert individual having M.S. or B.S. in the pre-clinical sciences. Some foreign language ability also desirable. Must be interested in abstracting and indexing or current scientific literature. Outstanding benefits including tuition assistance. Please submit complete resume.

Box 54, SCIENCE

EXPLORATORY RESEARCH SUPERVISOR

Ph.D. LEVEL

Opportunity to conduct and supervise an original exploratory program in the area of high polymer chemistry. Position requires a man with a high degree of creativity, initiative and ability to see that the program is carried on effectively. At least three years of experience in the polymer field required, preferably in thermoplastic resins. Will report directly to the Research Manager. Location at headquarters offices of new multi-million dollar plant site located on Ohio River near city of 60,000 population. Attractive relocation provisions and numerous other benefits. Salary open. Write in confidence to:

Dr. Robert Springborn, Research Manager

MARBON CHEMICAL DIVISION

Borg-Warner Corporation

Box 68, Washington, West Virginia



POSITIONS OPEN

(a) **Pharmacologist**, Ph.D. to establish evaluation program associated toxicity studies in new drug screening; \$8500; midwestern subsidiary of important company. (b) **Bacteriologist**, Ph.D. to conduct basic research, infectious diseases, participate in study, development of synthetic drugs; to about \$10,000; eastern organization. (c) **Biochemist**, busy modern laboratory, 200-bed Pennsylvania hospital; to \$7200. (d) **Bacteriologist**, M.S., Ph.D., to assist in production of bacterial, viral antigens; research institute affiliated prominent midwestern hospital. (e) **Biochemist**, M.S. to head section, 300-bed general hospital; to \$8000; midwestern college city. (f) **Bacteriologist**, M.S., Ph.D. trained virology, tissue culture; state approved laboratory, approved general hospital; New England. (Please write for analysis form. Our 64th year: Founders of the counselling service to medical profession: serving medicine with distinction over half a century.) Science Division, Woodward Medical Bureau, Ann Woodward, Director, 185 North Wabash, Chicago. X

Psychiatric Institute and Hospital. Oriented to interdisciplinary research, offers challenging and unusually rewarding opportunities to qualified research scientists. Positions available involve varying degrees of responsibility in the coordination, planning, development, and direction of research laboratories and programs and participation therein. Inquiries are invited from individuals with an M.D. or Ph.D. degree and research competence in the neurophysiology, virology, biochemistry, neuropsychology, and biophysics. Write Dr. Edward N. Hinko, Director, Cleveland Psychiatric Institute and Hospital, 1708 Aiken Avenue, Cleveland 9, Ohio.

Research Assistants needed in Histology, Biochemistry, Pharmacology, Physiology, and Physical Chemistry. Positions created by rapidly expanding new medical research program. Bachelor's degree in the chemical or biological sciences required.

Microspectroscopist. Advanced training or experience in optics, electronics, or cytology preferred. Open now for any starting date until September 1960. Apply Personnel Officer, Dartmouth Medical School, Hanover, N.H. X

Commonwealth of Australia, Commonwealth Scientific and Industrial Research Organization, Chemical Research Laboratories.

Applications are invited for the position of **Chief of the Division of Physical Chemistry** to succeed Dr. K. L. Sutherland who is taking up a research position in industry.

The Division of Physical Chemistry is one of the six major units of the Chemical Research Laboratories of C.S.I.R.O. which have their headquarters on a common site in Melbourne. A spacious new site has recently been acquired for the laboratories adjacent to Monash University, which is now being established at Clayton, Melbourne, Victoria. The division will be transferred to that site at some future date.

The division has an annual budget of approximately £A75,000, and has free use of library, central workshops, stores, canteen, clerical, and other facilities. It has a professional staff of 25, including 17 in the research classifications, and a total staff of 33. It has close liaison with industry, public utilities, the universities, and other parts of C.S.I.R.O.

The work of the division includes both basic research and applied research, and is centered about problems of importance to the nation or to development of the science of physical chemistry. Among its present projects are (i) the application of surface chemistry to studies of evaporation control in water storages (Mansfield process), to nucleation to form ice as a starter for rain formation, and to separation processes based on absorption; (ii) theoretical and experimental studies of the properties of liquids; (iii) chemical effects of high pressures up to 250,000 atmospheres; (iv) the chemistry of carbon; (v) metal organic complexes and enzymes; (vi) bush-fire research; (vii) desalination studies. The division's program has varied considerably over the past years and the successful candidate will have ample opportunity to influence future developments.

Applicants should have high academic qualifications and a considerable amount of research experience. Some experience as a scientific administrator is desirable.

The appointment will be conditional upon a satisfactory medical examination and carries with it Commonwealth Superannuation Fund or Commonwealth Provident Account privileges.

The salary offered for the position is £A4902 p.a.

Further particulars and a copy of the division's latest annual report may be obtained from the Director, Chemical Research Laboratories.

Applications quoting reference number 586/4, and stating full name, place, date and year of birth, nationality, marital status, present employment, details of qualifications and experience, and of war service if any, together with the names of not more than four persons acquainted with the applicant's academic and professional standing, should reach the Director, Chemical Research Laboratories, C.S.I.R.O., G.P.O., Box 4331, Melbourne, Victoria, Australia, by 2 May 1960. X

LIVE A FULL LIFE with Chemstrand Research Center



... in the Research Triangle of North Carolina

The Chemstrand Research Center will move to new and modern laboratories in the Research Triangle Park of North Carolina in late 1960. Why not move with us?

Because of the unique association of three major schools, Duke University, University of North Carolina, and North Carolina State College, in three communities of varied business activity within easy driving distance, the newly developed Research Triangle offers outstanding attractions for truly satisfying family life and an unusual intellectual climate for professional growth. This area was chosen after a six-month study of 21 locations because:

You and your family will enjoy living in this area where educational, cultural, recreational and residential facilities are top-notch.

You will find intellectual stimulation in the university atmosphere which will surround Chemstrand's expanding research program.

Research positions are available now for chemists, physicists, chemical engineers and other scientists at all degree levels, with or without experience. Current assignments will be in the present research laboratories at Decatur, Alabama. Transfer to the North Carolina facilities will be made when they are completed.

POSITIONS NOW AVAILABLE IN

- Preparation and evaluation of intermediates, monomers and polymers.
- Melt, wet and dry spinning of chemical textile fibers.
- Kinetics and mechanisms of polymerization and depolymerization.
- Rheology of polymer melts and solutions.
- Diffusion and absorption in polymer systems.
- Mechanical properties of polymers.
- Application of optical, X-ray and infra-red techniques to polymer structures.
- Properties and performance of textile fibers.

For Further Information Write To:

MANAGER, TECHNICAL EMPLOYMENT AND RECRUITMENT, BOX 5GR

THE **CHEMSTRAND RESEARCH CENTER INC.**

A wholly owned subsidiary of THE CHEMSTRAND CORPORATION

DECATUR

ALABAMA

TOMORROW'S BIG DECISIONS WILL BE MADE by the men who act today

The Market Place

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

DISPLAY: Insertions must be at least 1 inch in depth. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	\$40.00 per inch
4 times in 1 year	38.00 per inch
7 times in 1 year	36.00 per inch
13 times in 1 year	34.00 per inch
26 times in 1 year	34.00 per inch
52 times in 1 year	32.00 per inch

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

BOOKS AND MAGAZINES

Your sets and files of scientific journals

are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A35, CANNER'S, Inc. Boston 20, Massachusetts

Writers' Conference in the Rocky Mountains
July 25-August 12
offers Workshops in Popular Science
Designed for scientists who write for lay readers.
Directed by: **WILLY LEY**, famous scientist and popular writer.

HAROLD WALTON, scientist, article writer, teacher.
Other Workshops in Non-fiction, Novel, Short Story, Poetry, Juvenile Writing, Drama, and Book Review. For more information write Margaret Robb, University of Colorado, Boulder, Colorado.



DVORINE

Pseudo-Isochromatic Plates *

- Distinguishes the color-blind from the color-ignorant.
- Classifies the color-blind according to type and severity of defect.
- Special arrangement prevents malingering.

With Directions

\$15 each, less 5% if you send check

SCIENTIFIC PUBLISHING CO.
2328 Eutaw Place—Dept. S—Baltimore 17, Md.

MEDICAL & BIOLOGY FIELDS
142 CNS PATHWAYS

EXPERIMENTAL NEUROANATOMY

F. H. Johnson, Ph.D. (Cornell)
Holling Press, Established 1911
501 Washington St., Buffalo, New York

MAMMARY TUMORS IN MICE

AAAS Publication No. 22. By the staff of the National Cancer Institute, National Institutes of Health. F. R. Moulton, Ed.

7 1/4" x 11 1/2", cloth, 20 tables, 52 illus. Published 1945—Now offered at reduced price: \$3.00 prepaid orders by AAAS members, \$3.50 retail.

AAAS

1515 Massachusetts Avenue, NW,
Washington 5, D.C.

PROFESSIONAL SERVICES



LABORATORY SERVICES

for the
FOOD and DRUG INDUSTRIES
Drug Evaluation, Food Additive Studies
Chemical and Biological Assays,
Clinical Studies, Research

LAWALL & HARRISON

Box 5, 1921 Walnut St., Philadelphia 3, Pa. LO 3-4322

PROFESSIONAL SERVICES

PATHWAY RESEARCH LABORATORIES, Inc.

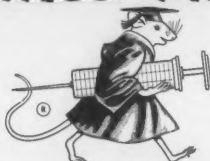
Fluorescent Antibody Reagents and Antisera
Contract Research and Consulting in Microbiology
and Biochemistry

Write for our free brochure

11102 South Artesian Avenue
Chicago 43, Illinois

SUPPLIES AND EQUIPMENT

SWISS MICE



Send for
booklet

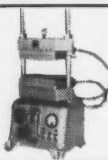
TACONIC FARMS

GERMANTOWN NEW YORK

WABASH HYDRAULIC LABORATORY PRESSES

Most complete line, 3 to 50-tons capacity. Heated Platens. Manual & motorized models. Ask for catalog.

Wabash Metal Products Co.
1614 Morris St., Wabash, Indiana.



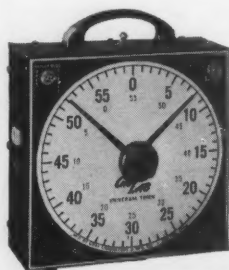
Laboratory Animals

Mice Hamsters Guinea Pigs
Rats Rabbits Rabbits

Information sent on request

H. S. HURLBURT

Animal Research Center, Bainbridge, N.Y.
Worh 7-5415



ELECTRIC

LAB TIMER

Giant 8" Dial

GRA LAB INTERVAL TIMER Automatic signalling and switching over unusually wide range of 3600 possible settings.
GRA LAB MICRO TIMER 1/10 sec. or 1/1000 min. stop clock. Remote start stop control. Write for catalog.

DIMCO-GRAY COMPANY
214 E. SIXTH ST., DAYTON 2, OHIO

ALBINO RATS

(Sprague Dawley Descendants)

Price List on Request

MACKESY FARMS

Phone ACademy 2-3334

Box 166 Route #4 Madison, Wis.

SUPPLIES AND EQUIPMENT

"From the hand of the veterinarian

to research."



albino rats

CHARLES RIVER CD
(Caesarean derived)
CHARLES RIVER SD
(Sprague-Dawley descendants)
CHARLES RIVER W
(Wistar descendants)

HYPOPHYSECTOMIZED RATS

- Only Charles River CD animals used
- Rigidly controlled environment (same bldg.) birth to surgery.
- High speed surgery by graduate biologists.
- 10 years experience animal surgery.
- Overnight air service from Boston

THE CHARLES RIVER BREEDING LABS

Dept. B, 1093 Beacon Street, Brookline 46, Mass.
Henry L. Foster, D.V.M., President

YOU NEED THIS FREE CATALOG FOR YOUR FILES

Serums, antisera and bloods of all kinds for technicians and tissue culture laboratories. No salesman will call.

COLORADO SERUM CO.

4950 York St. • Main 3-5373 • Denver 16, Colo.

• HYPOPHYSECTOMIZED RATS

Shipped to all points via Air Express
For further information write
HORMONE ASSAY LABORATORIES, Inc.
8159 South Spaulding Ave., Chicago 29, Ill.

Rats from the Wistar Strain

Laboratory Animals

since 1929

ALBINO FARMS, P.O. BOX 331
RED BANK, NEW JERSEY

Swiss Mice — Albino Rabbits

RABBIT BY-PRODUCTS

INCLUDING

SERUM **HEARTS**
BRAINS **LIVERS**
LUNGS **KIDNEYS**
EYES **SPLEENS**

ALL PRODUCTS FROM GOV'T
INSPECTED DOMESTIC RABBITS

**NATION'S LARGEST SUPPLIER OF
RABBIT BY-PRODUCTS**

WRITE FOR FREE BROCHURE
PEL-FREEZ Rabbit Meat Co.

Box 5318, Rogers, Arkansas



recti/riter® recorders prove what every engineer knows . . . SIMPLICITY MEANS RELIABILITY

What simpler and more reliable actuating device can you employ in an amperage-voltage-frequency recording instrument than a d'Arsonval galvanometer . . . a trouble-free horseshoe magnet and a coil of wire? The same is true of the exclusive "recti/rite"® system . . . a simple, shock resistant trigonometric linkage that straightens the arc described by the galvanometer metering arm, changing curvilinear motion to rectilinear motion.

All the other "recti/riter" recorder features which contribute to this instrument's multi-industry acceptance and hardworking reliability are equally simple: The optional a-c or d-c drives couple directly with chart speed change gears to allow ten chart speeds; all routine operations and adjustments are performed "up front"; the non-corrosive, honed metal alloy pens, closed ink system, and large capacity ink well give you long, consistent writing performance.

With all their simplicity and reliability, "recti/riter" recorders are offered in extremely wide and useful Basic Recorder Ranges (Dual channel recorders offer combination of any two ranges):

Two Cycle Pen Response

D-c Milliampere Ranges 1/4 ma to 100 ma
A-c Ampere Ranges 0.25 A to 25 A
D-c Ampere Range 100 mv for use with standard shunts
Expanded Scale A-c Voltage Ranges 80-130 V, 160-260 V, 320-520 V
A-c and D-c Voltage Ranges 10 V to 1000 V
Frequency Ranges 50, 60, 400 cps

Five Cycle Pen Response

D-c Milliampere Range 5 ma
-----------------------	------------

Ask the TI engineer about *customized* recorders for your OEM applications. Don't settle for any recorder until you know all the facts on the complete "recti/riter" recorder line.



TEXAS INSTRUMENTS
INCORPORATED

GEOSCIENCES & INSTRUMENTATION DIVISION
3609 BUFFALO SPEEDWAY • HOUSTON 6, TEXAS • CABLE: TEXINS

The proved "recti/riter" recorder is a companion to the new "servo/riter" recorder.

"servo/riter" is a trademark of Texas Instruments

Miss Julia E Rothermel

S

Western College

NF

29F33 Oxford Ohio

a new concept in Fluorometer-Nephelometer design . . .

Turner FLUOROMETER

**Full Scale Reading
(100 Divisions)
with only
5 PARTS per BILLION
Quinine Sulphate**



- ▶ Four-watt u.v. lamp minimizes sample deterioration
- ▶ Resolves 0.01 ppm silica when used as a nephelometer

A compact, stable instrument for quantitative fluorescence analysis, simple in operation and with extremely high sensitivity, i.e. 5 parts per billion quinine sulphate produces full scale (100 divisions) change on most sensitive range. Can also be used as a nephelometer to resolve as little as 0.01 APHA standard turbidity unit. Range selector provides for reducing the sensitivity if required.

Sample emission is determined by manually balancing its effect with that of a reference beam from the same light source upon a single photomultiplier tube, employing a rotating light interrupter to pass sample and reference beams alternately. Difference in relative a.c. detector output, amplified by a highly stable first stage, is sensed by a phase shift detector and fed to a null-type meter. Intensity of reference beam is regulated by a linear cam in the light path, which permits calibration in terms of 100 equal divisions on the "Fluorescence" dial. Design eliminates dark current effects; light source, detector and line voltage variations; and zero point error.

Takes 2-inch square filters for operation at 405, 436 or 546 mμ with 4-watt lamp and various secondary filters. Requires 2.5 to 4 ml samples in either standard test tubes, 10 to 12 mm inside diameter, or in 10 mm square cuvettes.

Adequate 3600A u.v. excitation is obtained with only 4-watt lamp output, thereby minimizing sample deterioration by light or heat. Interchangeable lamp (254 mμ), quartz cuvettes and special filters are available for 2537A operation.

Fluorometer, Turner, complete outfit with general purpose accessories for 3600A operation, consisting of set of five matched cuvettes 75 x 12 mm, primary filter 360 mμ, secondary filter 415 mμ, spare 4-watt ultraviolet lamp, and service manual; for 115 volts, 50 or 60 cycles, a.c. **985.00**

Square Cuvette, of Pyrex brand glass, precision bore, 75 x 10 mm; only accessory required for nephelometry **10.00**

Uranium Pellet Door, interchangeable with standard door. Standard fusion pellets drop into place and can be ejected by a spring device. **45.00**

Applications

agronomy
air pollution
biochemicals
clinical analyses
crime analyses
drugs
essential oils
fine chemicals
food chemistry
hormones
industrial hygiene
medical research
metals
petroleum
pharmaceuticals
semiconductor
research
toxicology
trace analyses
water contaminants
etc., etc.

Detailed descriptive bulletin sent upon request.



ARTHUR H. THOMAS COMPANY

More and more laboratories rely on Thomas / Laboratory Apparatus and Reagents

VINE ST. AT 3RD • PHILADELPHIA 5, PA.

